SEE FOLLOWING NOTE

PARTS OF THE ORIGINAL DOCUMENT

ARE OF POOR REPRODUCTIVE QUALITY

CERTAINES PARTIES DU DOCUMENT ORIGINAL

SONT DE PIÈTRE QUALITÉ DE REPRODUCTION

ENERGY
DRIVING FORCE OF ECONOMIC DEVELOPMENT

ENERGY POLICY

FOR THE 1990s

Québec

89-01899/

Distribution

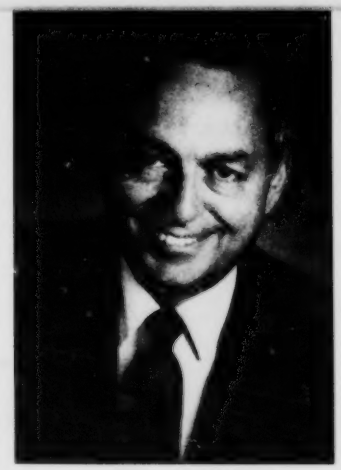
Information
Direction des communications
Ministère de l'Énergie et des Ressources
200 Chemin Sainte-Foy, 7th Floor
Québec (Québec)
G1R 4X7

Published by the
Direction des communications of the
ministère de l'Énergie et des Ressources

© Gouvernement du Québec 1988
Legal Deposit - 3rd Quarter 1988
Bibliothèque nationale du Québec
National Library of Canada
ISBN-2-550-18780-6
Publication No: E-21

This document is also available in French.

Cette publication est également disponible en français.



Economic exchanges in North America and throughout the world have intensified in recent years. Québec has responded to this challenge with ever greater efforts to consolidate its position so as to maximize the economic benefits of its resources, take advantage of its know-how and utilize its manpower to the fullest, thereby ensuring the growing prosperity and greater well-being of its citizens.

To achieve these goals, the Government will be relying in particular on its new energy policy. The focal points of this new policy are the accessibility to energy resources and the security and diversification of supply. A key aspect is to ensure energy efficiency and diversity while promoting competition to the consumers' benefit. The principal goal is to further the use of energy as a driving force in a strategy for economic and industrial development. This new policy also reflects the Government's firm intention to safeguard the environment.

The economic spinoffs from energy projects, their stimulating effect on the refining and petrochemical sectors, the influence of the diversity and security of energy supply in attracting and developing new businesses, and the competitive advantages thus provided to Québec business firms, are extraordinary assets that we must utilize to the utmost.

This new policy is in line with the commitment of the Prime Minister of Québec, Mr. Robert Bourassa, to make energy an essential tool of our economic development. It comes as a logical continuation to a whole series of Government actions that, over recent years, have helped create an economic environment more conducive to investment, business development, job creation and income growth.

***Energy, Driving Force of Economic Development** will enable each of you to learn about the directions and choices that will be favored by the Government in the coming years and to better understand the risks and opportunities that lie in store for a Québec determined to master its energy future.*

John Ciaccia
Minister of Energy and Resources

TABLE OF CONTENTS

SUMMARY	1
INTRODUCTION	11
QUÉBEC'S ENERGY SECTOR ON THE EVE OF THE 1990s	13
OPPORTUNITIES AND OBJECTIVES	41
ELECTRICITY	45
NATURAL GAS	61
OIL AND PETROCHEMICALS	71
ENERGY EFFICIENCY AND DIVERSITY	83
RESEARCH AND TECHNOLOGICAL DEVELOPMENT	93
ENERGY AND THE ENVIRONMENT	99
THE ROLE OF THE GOVERNMENT	111
A NECESSARY COLLABORATION	117

SUMMARY

On the eve of the 1990s, facing the new context of the globalization of economies, Québec society is confronted by important economic challenges. The government is convinced that Québec possesses, in the energy sector, many of the instruments allowing it to pick up the gauntlet.

Our assets are many. With respect to energy supply, Québec has access to abundant resources. On its territory, large-scale projects have led to the development of considerable hydroelectric resources. Within Canada, an important system of oil and gas pipelines links Québec distribution centers to western fields. Québec also has open access to the international oil market. As for energy demand, the energy market is more competitive, more efficient than it ever was. Over the past few years, consumers have demonstrated their ability to adapt to supply conditions.

These assets have earned the energy sector an essential position in Québec's economic system. Out of hydroelectric developments, Québec has built a sector of activities and developed areas of expertise, whose performances are measured on an international scale. A major source of investments, Québec's energy sector is also a powerful industrialization factor. Québec's energy assets have been very attractive to energy-intensive industries.

The full exploitation of these advantages constitutes a particularly exciting challenge for the next decade. The yet untapped hydroelectric potential remains impressive. The renewable feature of hydroelectric energy confers an exceptional value to this potential. It also means that any delay in its development represents an irretrievable shortfall. The existence of a dynamic domestic market, the proximity of regions where future requirements are high, both guarantee a solid base for future developments of this potential. Energy costs and price stability can represent a determining factor in the ability of Québec enterprises to compete. The impact of the growth of the energy sector on the industrial structure and regional economic development can be further reinforced and maximized.

Appropriate action also offers means to remove many of the uncertainties of the future. The international energy market is unstable and prone to periodic imbalances. Security of supplies thus remains a major concern. Québec's access to Canadian fossil-fuel resources at competitive prices is a means of both strengthening this security and ensuring competitive supplies for many strategic sectors of economic activity. The development of Montréal's petrochemical industry is tied to conditions of supplies of oil and natural gas liquids. After undergoing a difficult period of adjustment, the refining industry must be consolidated and strengthened.

Through its energy policy, the government intends to fully exploit our assets and accept the economic and energy challenges of the future.

Energy Policy Objectives

Over the next few years, government action in the energy sector will be carried out with certain priority objectives in sight. These objectives will guide the government's overall energy policy. In some situations, delicate and difficult choices will of necessity be made between them. However, the government considers they can be pursued simultaneously by means of a strategy relying on the energy sector to meet the challenges of the 1990s.

[1] The government **will utilize the energy sector to spur economic development and support regional development**. It will make full use of the energy assets available to Québec to support and reinforce growth. Energy will therefore serve to increase investments and employment, diversify the industrial structure, improve the balance of trade, and contribute to the implementation of the government plan of action with respect to regional development.

- The government is well aware of the primary role played by energy in industrial development. **One of the goals of the government is to maximize the industrial spinoffs from energy activities** - construction spinoffs from the building and development of energy projects, and production spinoffs from the use of energy.

Among its efforts to encourage industrial growth, the government will pay special attention to technology transfers and research activities.

[2] The government **will develop and maximize the use of our hydroelectric resources**. This objective is based on the very nature of the hydroelectric resource, on the numerous possibilities for its development and utilization, and on the major related economic spinoffs.

[3] The action of the government will aim **to ensure and reinforce security of energy supplies**. The development of the abundant hydroelectric resources and the improvement of efficiency in the use of energy will directly contribute to such reinforcement. Québec's access to all Canadian and foreign sources of fossil fuel supplies at competitive prices is an essential element of this security.

[4] One of the government's specific objectives is **to guarantee Québec's access to Canadian resources at competitive prices**. Such access is the very condition of the development of numerous sectors of activity. This is especially true of petrochemicals.

[5] The government will foster **competition in the energy industry for the benefit of Québec consumers**. Opening markets to the main forms of energy to invite greater competition is an objective of social fairness and economic development alike.

Québec consumers will be in a position to make choices that are more enlightened and at better prices. Sound flexibility with respect to the relative price of the various forms of energy will improve the competitiveness of enterprises, as well as industrial development. It will incite all parties to be more efficient.

[6] In order to ensure harmonious economic and energy development, **the government will include greater energy efficiency and diversity** among its main objectives. The goal of greater energy efficiency and diversity is both a better utilization of existing energy sources and the promotion of alternative energy forms now being developed technologically. Greater energy efficiency and diversity are thus important means of supporting economic and industrial development, improving security of supplies and fostering competition between the various energy sources.

[7] Finally, the government's entire energy policy will be applied with **the constant concern of protecting the environment and the quality of life**. It is becoming increasingly clear that economic development will not endure if it leaves in its wake the continued degradation of the environment. However,

protecting and improving the environment require considerable economic and financial resources, sustained technological support as well as solid and lasting economic growth. For the government, economic development, the growth of the energy sector and the protection of the environment are not, by any means, contradictory objectives. They must go hand in hand and be carried on simultaneously.

Energy and Economic Development

All the energy assets on which Québec can rely must be used to support and strengthen the development of economic activity. Actions designed to develop the wealth of our energy resources, improve security of supplies, as well as diversify and guarantee exchanges with Canadian and non-Canadian partners are all prompted, in the last analysis, by the growth and development of the economy. Therefore, the primary goal of the government in the application of its energy policy is economic development.

Economic Development and Québec's Energy Resources

By relying on its energy resources, the Government means to encourage investments and employment, strengthen and develop Québec's industrial structure, maximize industrial spinoffs and improve the balance of trade.

The strategy of economic development is based above all on a major asset: an economically harvestable hydroelectric potential. In the past two years, the government has set in motion the first stage of its plan of action by inviting Hydro-Québec to resume its major hydroelectric development projects. The LG-2A power plant at James Bay, the Radisson-Nicolet-Des Cantons direct current line, Phase II of the La Grande complex as well as the construction of other production and transmission facilities are projects that in the years to come will require billions of dollars of investments and create tens of thousands of job-years. The government plans to authorize the construction of new power plants. Means will be taken so that these developments have the utmost impact on the economy.

Proceeding ahead of schedule for the construction of all the power plants in Hydro-Québec's installations program was made possible by the effective canvassing of export markets. The government is convinced there is still an important sales potential in these markets for the year 2000. It will therefore pursue its strategy of the promotion of electricity exports and of deregulation in cooperation with Hydro-Québec as well as with Canadian and American intergovernmental agencies.

Additional human and financial resources will thus be earmarked for the development of export markets by both the government and Hydro-Québec. Electricity export products will be diversified in order to benefit fully from the complementarity and special requirements of the American networks. To this end, an effort will be made to negotiate contracts for the sale of guaranteed energy and power as well as of firm energy and seasonal power. Québec is committed, however, to offering interested Canadian networks electricity at conditions comparable to those offered American customers. To maximize the profitability of exports, the government will ensure that guaranteed energy and power contracts include pricing formulas that reflect their true production costs. Together with the Canadian provinces and American states concerned, the government will study mutually advantageous opportunities of reaching new markets.

In addition to allowing Hydro-Québec's equipment plan tc proceed ahead of schedule, electricity exports will eventually lead over the years to lower electricity rates for Québec consumers. They will improve Québec's balance of energy exchanges and balance of trade.

Besides its strategy for the development of production infrastructures and exports, the government will adopt measures to reinforce and develop Québec's industrial structure. It will see that Hydro-Québec's rate schedule fosters the establishment of new enterprises and the expansion of existing ones. The government will stimulate the establishment and expansion of energy-intensive industries using electricity. To this end, to foster industrial development, it will request Hydro-Québec to keep a certain reserve of power and energy. Since the use of efficient electric technologies also favors competitiveness, the government will invite Hydro-Québec to set up a new, more aggressive program to introduce electrotechnologies. The penetration of these clean technologies will improve the quality of the environment and of the workplace.

Needless to say, the objectives set forth in the electricity sector will be pursued bearing in mind the profitability of Hydro-Québec's operations.

Economic Development and Access to Canadian Resources

Many of the projected measures in the fossil fuel sector will encourage economic development. The government will thus favor investments to expand and consolidate gas distribution networks, and will use the availability of natural gas to attract new enterprises.

In the oil sector, the economic stakes are linked especially to the vitality of the refining and petrochemical industries. The government has recently taken measures, therefore, to foster the consolidation of the refining industry in Québec. Tax breaks will improve the ability of Québec refiners to compete. Besides refining,other petroleum operations also spawn important industrial spinoffs. The government is actively promoting the establishment of these activities, and will take the necessary means to introduce them.

Moreover, the government will encourage the growth of the petrochemical industry by ensuring it competitive access to all available feedstocks. To this end, the government has already mandated SOQUIP to promote and develop the Soligaz project in a joint venture with other private and public parties. The implementation of the Soligaz project will constitute one of the most constructive measures for the future of the petrochemical industry in Québec. With regard to energy, Québec will possess, once the Soligaz project is completed, facilities allowing it to receive the full range of fossil fuels at competitive prices (oil, natural gas and natural gas liquids). The implementation of Soligaz would entail direct investments that could amount to 300 million dollars.

But it is on the level of downstream investments that the spinoffs from Soligaz are most promising. Indeed, in the short and medium term, Soligaz could attract in its wake direct investments in the order of one billion dollars to the Montréal region.

Security of Energy Supplies

The government will seek to ensure and strengthen the security of energy supplies. The development of Québec's abundant hydroelectric resources and the improvement of energy efficiency will contribute directly to such reinforcement. The specific objective of guaranteeing Québec's access to Canadian fossil fuel resources is an essential part of this security.

In its dealings with the federal government and with the other provinces, the Québec government will seek to maintain access to all the fossil fuel supply sources from the Canadian producer regions at a competitive cost. In particular, it will seek to preserve and ensure Québec's access to Canadian oil and natural gas liquids at prices comparable to those on international markets. It will promote concerted action with the governments concerned to ensure the viability of the three main pipelines used by Québec's oil industry. Finally, it will support the continuation of underground exploration in Québec by various private parties by granting them access to the geoscientific information available in Québec.

Benefit to Québec Consumers

Many of the measures proposed as part of this policy will be of benefit to Québec consumers. For instance, keeping in use the networks giving access to Canadian and foreign fossil fuels and enabling them to be more profitable, as well as expanding and developing natural gas distribution networks, will foster increased competition on the energy market. This will allow Québec consumers to make more enlightened choices between the various forms of available energy at better prices.

In the hydroelectric sector, the government will continue to directly approve electricity rates. The main criteria to be applied in setting these rates will be Hydro-Québec's financial situation, production costs, the competitive position of electricity, the fair treatment of customers and the ability of Québec consumers to pay. The government will examine new rate options for electricity consumers. It will study the possibility of integrating daily and seasonal rates - in order to favor, on the one hand, the elimination of peak periods and, on the other, the use of electricity in off-peak periods. Such a measure would help reduce the electricity bill of consumers. The government also intends to pay special attention to the quality of service offered electricity users: it will ask Hydro-Québec to speed up the investments provided in the latter's service quality enhancement program. Additional measures will have to be taken by Hydro-Québec to reduce the frequency and length of breakdowns.

Besides, at the present time, electricity is the only form of energy distributed by a public utility for which there is no means of recourse for the consumer. The government will therefore study the possibility of setting up an impartial appeal procedure for disputed cases. All the services offered customers will be reviewed to increase efficiency, simplify processing and reduce costs.

In the natural gas sector, government actions toward a uniform rate structure, a greater consolidation of the networks and the establishment of gas-to-gas competition will also be beneficial for Québec consumers. For instance, unifying natural gaz rates will help reduce regional disparities. It will make all consumers benefit from investments made by Quebecers collectively. Furthermore, unified rates will foster the consolidation of distribution networks, which in turn will result in reducing distribution costs and, therefore, the price of gas. Finally, the gov-

ernment will ask the signatories of the Agreement on Natural Gas Prices and Markets to give producers open access to the Québec residential, commercial and institutional markets. The competition between producers that will ensue will also put pressure on prices to fall.

Concerning the distribution of petroleum products, considerable structural changes have affected the level of competition in the various markets. In this context, the government has created the Bureau d'inspection et d'information du prix de l'essence (BIPE). Through this agency, the government upholds the free exercise of competition in the retailing of gasoline sales. It will thus give populations less likely to benefit from this competition the assurance that they will be in a position to know market conditions and real costs. By creating this agency, the government relies first and foremost on the full exercise of competition based on direct action by consumers in the various markets.

Energy Efficiency and Diversity

Government strategy for achieving greater energy efficiency and diversity is aimed at both a better use of existing energy supplies and the promotion of alternative sources of energy undergoing technological development.

Energy potentials will be developed in sectors where they are highest and economically most profitable. The most important potential for the improvement of energy efficiency is found in the industrial and commercial sectors. That is why the government will spend the major part of its efforts and resources in these sectors through technology transfers and energy audits, and by partially financing feasibility studies. In the residential sector, the government will see that, through its programs of information and of assistance for demonstrations, specialized parties are familiar with construction techniques and with the availability of materials and equipment demonstrating a high level of energy efficiency. Finally, in the transportation sector, the government will pay special attention to the promotion of energy efficiency in municipalities by means of demonstration projects.

In the area of alternative energy forms, the government will seek to speed up the achievement of the technical and economic viability of alternative energy forms. The main effort will center on research, development and, given substantial contributions from the private sector, on commercial demonstration projects. The government will continue to offer its support to organizations devoted to the promotion of new technologies.

In particular, four areas are likely to rank high in the production of alternative energy or in technological development over the next few years. They are: the use of hydrogen as an energy vector, the recovery of energy from urban waste, the combustion of wood residues in certain industries, and the development of technologies to produce alternative fuels from forest biomass. The government will exert special efforts in these areas.

Protection of the Environment and Quality of Life

The government's energy policy will always be applied with the constant concern of protecting the environment and the quality of life. For the government, economic development, the growth of the energy sector, the protection of the environment and quality of life are by no means contradictory objectives;

rather, they should be carried on simultaneously.

The exploitation of alternative energy sources brings certain elements of solution to the environmental problems we are actually experiencing. That is why the government plans to maintain its contribution to the development of alternative energy sources using the available and renewable resources most likely to alleviate environmental problems. The support it will grant research and experimentation on new or improved processes will depend on the parallel development of equipment required for environmental protection. Consequently, it will ensure that these processes have been thoroughly tested as to the protection of the quality of the environment prior to their marketing and distribution.

With regard to the use of fossil fuels, the government has increased its efforts to ensure public safety and the protection of the environment during the past two years, in particular by passing the new Act respecting the use of petroleum products and by revising those parts of the Mining Act that deal with hydrocarbons. In the years to come, its efforts will focus on the strict application of the related regulations, especially to prevent soil contamination. In addition to monitoring the safety of facilities, the government will continue its efforts to ensure the quality of products and the control of air pollution caused by the combustion or the evaporation of petroleum products.

With respect to the production and transmission of hydroelectric energy, it is essential in long-term planning to take into account the economic and environmental components simultaneously. Regarding transmission facilities, various means will be taken to improve consultation with the populations concerned. Moreover, the projects in question must be carried out in full respect of the rights of native peoples occupying the territories affected.

On an institutional level, the government will continue to submit to rigorous environmental studies the installation of new transmission facilities, the construction of power plants and transforming stations as well as the creation of reservoirs. It will seek mechanisms capable of ensuring a better integration of economic, technical and environmental components when reviewing development projects, if need be, by creating a coordinating committee to promote consultations and unify procedures or by broadening the mandate of some agencies. The concerns expressed by citizens will be taken into greater consideration by encouraging increased public participation at the various stages of project planning.

The government will ask Hydro-Québec to pay special attention to the visual impact of overhead transmission and distribution lines. This effort will concern primarily environments that are highly valued as tourist attractions or heritage sites. With respect to transmission, the government will be particularly careful regarding the St. Lawrence Valley. It will request that Hydro-Québec give priority to the protection of scenery with acknowledged value. Moreover, the government will see that henceforth no new corridor is opened for overhead lines across the St. Lawrence. Finally, it will entrust Hydro-Québec, while pursuing its program to improve existing facilities, to undertake a program to dismantle lines and stations that are no longer in service.

The Role of the Government

In an economy based on free enterprise, where responsibilities are shared at different levels, it is neither possible nor desirable for a government to attempt to carry out all its objectives through direct intervention.

The role of a government is rather to inform economic agents and, in some cases, encourage them to act where benefits for all of society far outweigh mere private profitability. The government must also protect all citizens against potential abuses. The State can also act as an economic agent in very specific cases where private enterprise of itself is unable to meet the challenges, especially of economic development. Lastly, the government's mission is to defend and promote Québec's economic and political interests before other levels of government in Canada and abroad, as well as to back the efforts of its institutions and enterprises on foreign markets.

To encourage as well as to undertake, the government relies on its public corporations. In Québec's energy sector, Hydro-Québec and SOQUIP play a major development role. Hydro-Québec constitutes the province's single most important instrument in dealing with the energy sector. The size of this corporation allows it to muster the financial and human resources necessary to harness Québec's considerable hydroelectric potential for the benefit of all Quebecers. Hydro-Québec thus serves as a complement to the government whenever it carries out a certain number of missions that cannot be accomplished by government services. It is through Hydro-Québec that the government can undertake development projects, invest, purchase and sell goods and services. It is also through Hydro-Québec that it can support in a significant manner research and development for electricity-related activities.

The roles of Hydro-Québec and of the government are thus complementary. Within the framework of general policies and orientations defined by the government, Hydro-Québec sets in motion the actions that will turn these policies into effective programs.

Similar relations exist with SOQUIP, even though the government corporation involved in the fossil fuel sector exercises this activity in a very different context. SOQUIP is a corporation that allows the government, in a sector where its means of action are more restricted, to encourage the implementation of economic development projects in collaboration with private enterprise.

The expansion and internationalization of the Québec economy reinforce the need to increase cooperation links with other governments and government agencies. In promoting Québec's interests abroad, the government will put special emphasis on its relationship with French-speaking countries by relying on the Institut de l'énergie des pays ayant en commun l'usage du français.

This institute will be established in Québec City during 1988.

The government has at its disposal a certain number of instruments of action, some of which are quite powerful. However, the government's energy policy is based on the collaboration of all the parties involved — energy producing and distributing enterprises, energy consuming industries, suppliers of goods and services, other governments, but most of all, the citizens themselves, whose behavior will determine the final choices in the matter.

INTRODUCTION

To make full use of the energy sector to support Québec's economic and industrial development; to develop the abundant resources available to us and use them as best we can for the benefit of all Québecers; to rely on the energy assets from which we benefit to pick up the gauntlet of the globalization of the economy; to improve still further the conditions of energy consumption, the efficiency of its use and the adaptation of the energy market to energy supplies; and to pay special attention to the sector's development as it affects society's delicate equilibrium, and especially in environmental matters. For Québec, the objectives of an energy policy appear easy to define. The abundant resources and assets available to us, the concerns raised by certain difficulties, present or expected, seem to indicate the direction in which our efforts must be deployed and the objectives we can pursue.

Still, this direction and these objectives mustbe explicitly declared and identified. They must be based on a clear understanding of our situation, of our assets, of the context in which we live. The means chosen by the government to reach them must be set in place and defined. The very role that the government assigns itself in the energy sector must be understood and emphasized.

In stating the energy policy it intends to follow in the coming years, the government aims at no other goal. Québec society is facing considerable economic challenges. On the eve of the 1990s, the government is convinced that Québec possesses, in the energy sector, many of the instruments allowing it to pick up the gauntlet. The responsibility is considerable, but the objectives to attain are within reach, and the means of attaining them are to a great extent already in place. For its part, the government is determined, here as elsewhere, to assume its share of the responsibility.

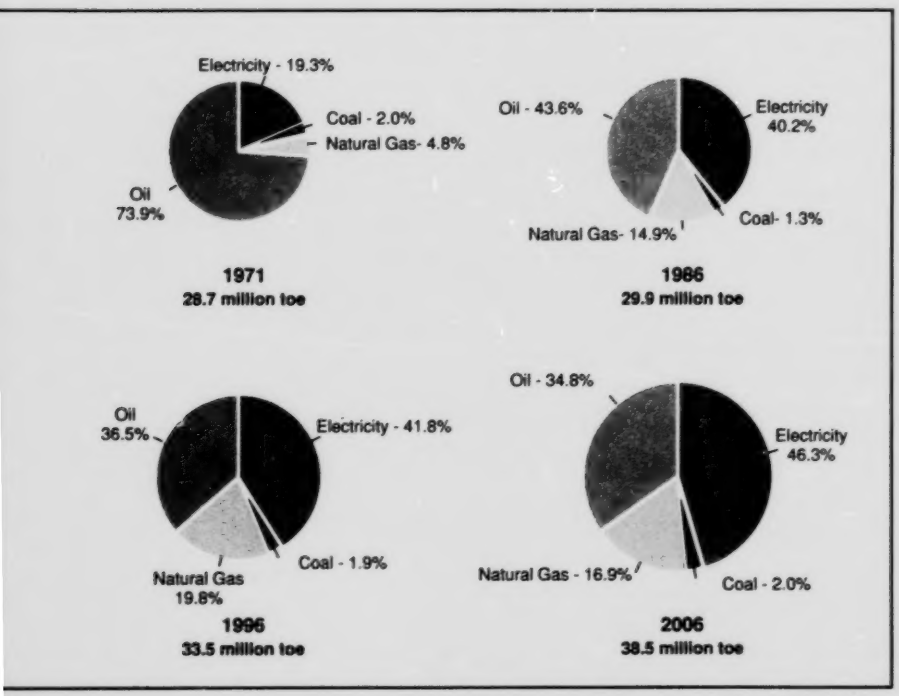
QUÉBEC'S ENERGY SECTOR ON THE EVE OF THE 1990s

- **A Competitive Energy Market, More Efficient, with a Proven Ability to Adapt**
- **Abundant Energy Resources**
- **An Essential Place in the Economy**
- **Energy and the Environment: the Emergence of a New Equilibrium**
- **An Unstable International Energy Context, Still Dominated by Oil and Increasingly Competitive**

A Competitive Energy Market, More Efficient, with a Proven Ability to Adapt

Some facts stand out when Québec's energy situation is analyzed. The first concerns the energy market itself: near the end of the 1980s, Québec's energy market is more competitive, more efficient than it ever was, and it has shown its great ability to adapt to the supply conditions imposed on it.

Graph 1
Demand by Energy Form
(excluding non-conventional energy sources)
1971 - 2006



Sources: **Energy in Québec,** 1987 Edition and MÉDÉE 3 - Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006,** October 1987.

A Transformed Energy Balance Sheet

The main statistical data are known: in fifteen years, Québec's energy balance sheet has undergone a profound upheaval. In 1971, oil held 75% of the energy market, while the remaining 25% was divided between electricity (20% of total consumption) and natural gaz (5%). In 1986, the situation is altogether different. Oil represents less than 45% of Québec's energy balance sheet. Electricity, with 40% and natural gas, with 15%, have respectively doubled and tripled their share of the entire energy market in Québec.

In 1971, electricity was indeed confined to its traditional uses in the residential and commercial sectors (lighting, the operating of electrical and household appliances). Natural gas, for its part, was used mainly by industrial consumers and in a few limited regions of Québec, transportation and distribution networks being restricted to Montréal and some zones in western Québec.

Fifteen years later, electricity is by far the leading energy form consumed in the residential, commercial and industrial sectors. With respect to the role played by the various energy forms in the total energy picture — that is, including the transportation sector, still entirely captive of petroleum products — electricity is on the verge of catching up to oil. Natural gas also occupies an essential place now: it ensures one-fourth of the energy needs of the commercial and industrial sectors, where it ranks as the second form of energy used. In fifteen years, electricity consumption has doubled and that of natural gas tripled.

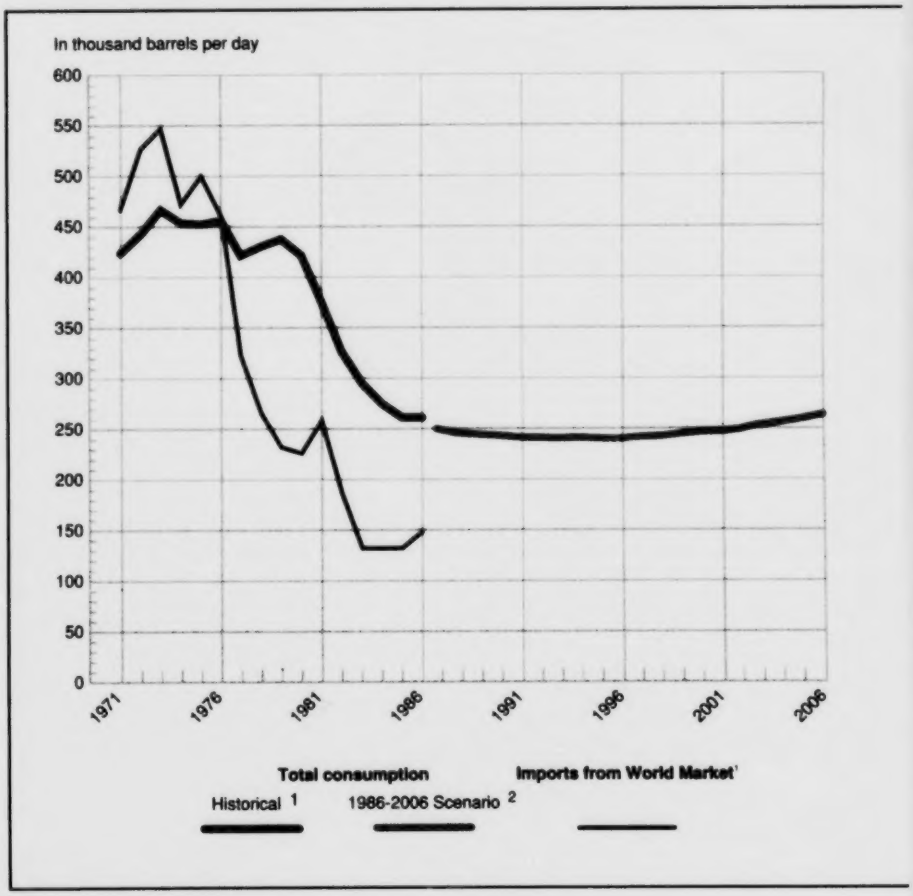
The speed and magnitude of this change must once again be underscored. There is nothing like it in any other Canadian province or major industrialized country. Since the early 1970s, no group has changed its

way of consuming and supplying energy as rapidly. This serves to show that, in the face of the energy crisis, Québec was able to react with very great speed, first by making efficient use of the natural resources found on its own territory, then by turning to those to which it had access in Canada.

This change is still more striking if one considers the phenomena surrounding the use of biomass. Québec's energy picture would indeed be incomplete if it did not show the growing role played by this energy form in Québec. Classified as a non-conventional form of energy, it is now often used in the industrial and residential sectors. Putting a figure on its contribution is a delicate exercise: biomass is marketed along networks that make it difficult to gather statistical data. However, it is estimated that in 1986 urban and forest biomass contributed about three million tons of oil equivalent (toe) to Québec's energy balance sheet, which represents about 9% of the energy market that includes them. The use of urban biomass — that is, urban waste — and especially of forest biomass has slightly more than doubled in fifteen years. There too, in some sectors of consumption, users were able to rapidly change their sources of supply, exploit accessible energy resources and thus respond efficiently to the new conditions of the oil market.

In effect, the very rapid transformation of Québec's energy balance sheet was obviously a response to the energy crisis, the increase in the price of oil and the insecurity caused by the over-dependence of the energy sector on the international oil market. On this score, the result is also quite impressive. In addition to the penetration of natural gas and electricity, energy conservation and the substitution of some international oil by Canadian oil had the overall effect of considerably reducing the quantity of oil imported from abroad. In fifteen years, the volumes of crude oil purchased by Québec on the world market fell by nearly 70% and in 1986 represented only one-third of what they were in 1971. Here too, with the exception of the new oil producing countries of the North Sea, there is no example among the industrialized countries of such a rapid and large

Graph 2
Crude Oil Imported from World Markets and Total Consumption of Petroleum Products in Québec
1971 - 2006

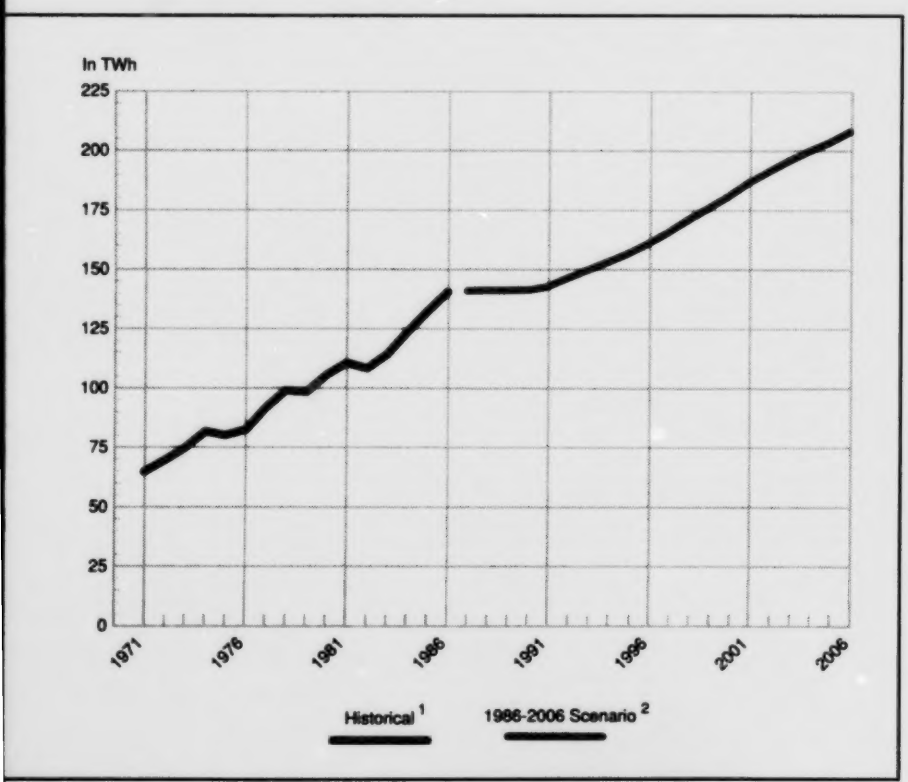


1. Source: **Energy in Québec**, 1987 Edition.
2. Source: MÉDÉE 3 - Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006**, October 1987.

reduction of the dependence on international oil.

Are these changes completed? Have these transformations ended? Apparently not. Analyses actually available on the changes in Québec's energy balance sheet for the next twenty years conclude that the inroads made by electricity will continue, that the role played by natural gas will be reinforced and then will stabilize, and that the share of oil will be further reduced. More specifically, Québec's electricity consumption should jump 50% by 2006, that of natural gas and non-conventional energy forms 45%, while oil consumption would remain virtually unchanged.

Graph 3
Total Electricity Consumption in Québec (in TWh)
1971 - 2006



1. Source: **Energy in Québec,** 1987 Edition.
2. Source: MÉDÉE 3 - Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006,** October 1987.

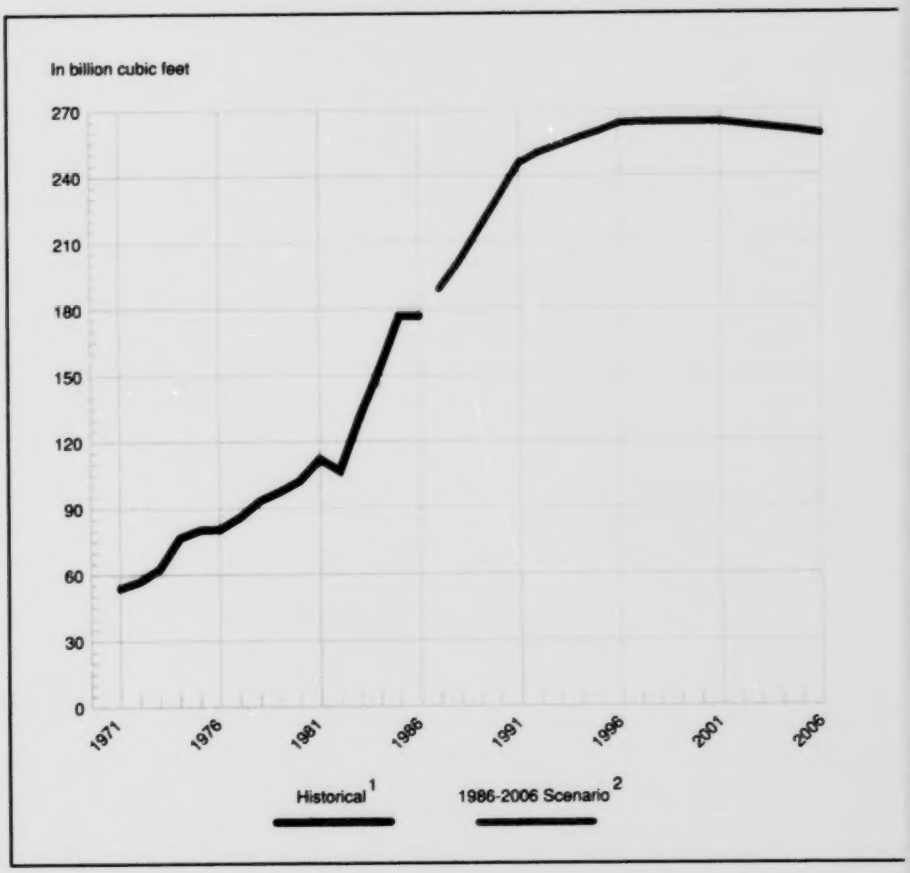
These results are worth a few comments. In itself, the continued penetration of electricity on the energy market would be quite remarkable. It would concern an energy balance sheet that is already strongly weighted in favor of electricity, since Québec is probably one of the industrial societies where electricity already plays the most important role. According to the most probable scenario, the continuing penetration of electricity would affect the residential, commercial and industrial sectors alike. The additional consumption of electricity, from 1986 to 2006, would reach a total of nearly 70 TWh, thus increasing Québec's electricity consumption from 139 TWh to 208 TWh. The average annual rate of increase of electricity consumption would reach 2% for the entire period, or 1.6% between 1986 and 1996, and 2.4% between 1996 and 2006.

According to the scenario selected, the relatively slower rise in demand over the next ten years is due largely to the end of surplus electricity sales on industrial markets. If only "regular" electricity sales are considered, each year Québec's electricity consumption would increase, on the average, 2.6% between 1986 and 1996, compared to 4.3% between 1976 and 1986. Despite the very strong upward movement recorded in the past ten years, there still seems to exist a significant development potential for this form of energy on the domestic market.

As regards natural gas, available analyses suggest that the stabilization of Québec's consumption will begin in the early 1990s.

More specifically, consumption, which stood at 177 billion cubic feet in 1986, would continue to grow strongly until 1991 and reach nearly 265 billion cubic feet by 1996. It would stabilize around this level for the following ten years. According the most probable scenario, the strong growth forecast for the next five years is in part tied to the recovery, by natural gas, of the industrial heating markets captured by electricity thanks to sales of surplus energy. However, according to these analyses, Québec's consumption of natural gas appears very sensitive to variations in economic growth as well as to changes in the price of crude oil. This sensitivity is particularly apparent in the commercial and industrial sectors.

Graph 4
Total Comsumption of Natural Gas in Québec
(in billions of cubic feet)
1971 - 2006



1. Source: **Energy in Québec,** 1987 Edition.
2. Source: MÉDÉE 3 - Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006**, October 1987.

Actual analyses forecast a new reduction of Québec's oil consumption, at least until the early 1990s, essentially owing to a drop in the demand for light fuel oil. Oil consumption would then begin a certain upturn, which would result in a rise in the demand for gasoline. According to these analyses, Québec's consumption of petroleum energy products (not including products such as asphalt and petrochemical feedstocks) would reach 264,000 barrels per day by 2006, or an increase of 5% compared to the 1986 level of consumption (251,000 barrels per day). Thus, the decrease in the importance of oil on the Québec energy market is expected to continue, although this decline has nothing in common with the sharp fall recorded in the past decade.

This phenomenon is easily explained. The replacing of oil by natural gas and electricity (particularly in the residential sector) will be nearly over by 1996, while energy savings in the heating of buildings will also be completed. The improvement of the efficiency of the stock of automobiles will also wind down rapidly after 1991. In effect, it is estimated that oil will have virtually disappeared from the residential sector by 2006 and that it will play only a very limited role in the industrial and commercial sectors. Over the next twenty years, the transportation sector should constitute the only source of increased oil consumption.

It is expected that between now and 2006 demand for non-conventional energy forms in Québec will grow only slightly more than the average increase of total energy demand. Over the next ten years, there should be a fairly strong increase in the consumption of forest biomass in the industrial sector. This advance is, for the most part, due to the sustained growth of activities that use this form of energy in the pulp and paper sector. On the whole, forest and urban biomass would continue to represent the near total share of non-conventional energy forms used in Québec.

Non-conventional energy forms are used primarily in two clearly identified markets, namely, those that cater to the heating needs of the industrial and the residential sectors. By 2006, the situation should remain virtually unchanged since the residential and industrial sectors together would represent over 90% of total non-conventional energy demand. However, certain non-conventional energy sources (oxygenated fuels) could make some inroads on the fuel market and deprive petroleum products of the exclusive role they actually play in the transportation sector.

Competitive Markets

Still on the subject of Québec's energy market, the appearance and development of very competitive demand sectors are another characteristic of the past fifteen years.

In 1971, the Québec energy market was divided roughly into three sub-markets, where consumers had access virtually only to a single form of energy. The first of these sub-markets was the heating market, namely, water and space heating, which represented nearly 60% of the total energy requirements of Quebecers. Technically, it was possible on this market to choose between numerous forms of energy to produce heat. In practice, however, petroleum products constituted for the vast majority of consumers the only energy form physically or economically accessible for space heating. At the time, oil thus occupied slightly more than 75% of the heating market. The remainder of the market was supplied by wood, natural gas and, to a lesser degree, coal and electricity. The uses of electricity on this market were limited to water heating and, for a small number of dwellings, space heating. Together, all the forms of energy other than oil represented less than one-fourth of the heating requirements of Québec consumers.

The second sub-market consisted of energy demand for transportation. In 1971, this market represented slightly more than 25% of total energy demand and was entirely captive of petroleum products, with the sole exception, of course, of Montréal's electricity-powered subway system.

Finally, the third sub-market, constituting approximately 15% of total energy demand, consisted of all the uses traditionally covered by electricity, namely, lighting, the use of electrical and household appliances in the residential and commercial sectors as well as the use of electricity for power and processes in the industrial sector. This market was occupied entirely by electricity.

Between 1971 and 1986, the relative importance of each of these three markets changed. The heating market now represented less than half of total energy demand. Inversely, the relative share of the traditional uses of electricity increased greatly, while the importance of the transportation market remained unchanged: it is estimated that in 1986 these two sub-markets each represented 25% of the total energy market. In 1986 as in 1971, these two sub-markets were still dominated by a single form of energy, electricity

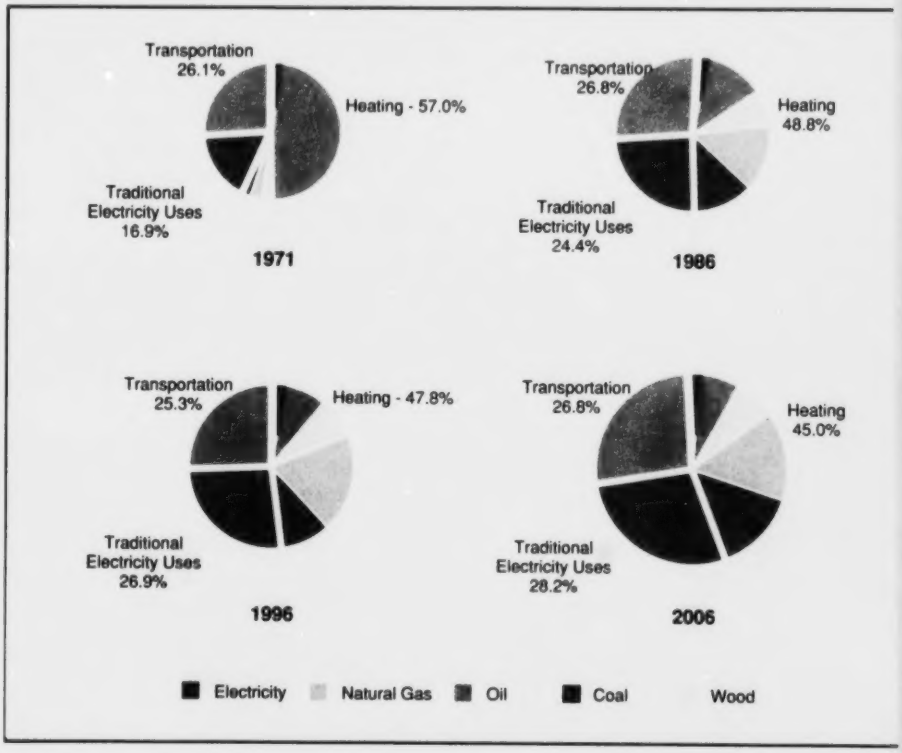
for the first and petroleum products for the second.

The new phenomenon, which in fact had a profound effect on Québec's entire energy situation, concerned the heating market. Over the past fifteen years, this market has become very competitive since consumers have had the possibility of choosing between two, three or sometimes four energy forms. The physical availability of natural gas, the reduction of the relative cost of electricity, the rise in the price of oil, government subsidies encouraging the substitution of petroleum products have helped open this market to competition between the various forms of energy. This phenomenon has very rapidly transformed the Québec energy balance sheet.

In 1986, slightly over 80% of the heating market was divided almost evenly between oil, natural gas and electricity, while the remainder was occupied by urban and forest biomass and by coal. It is clear this market was open to true competition. The effects were very beneficial for consumers: besides replacing oil by energy forms produced in Québec or in the rest of Canada, the gas-oil-electricity competition forced energy producers and distributors to increase their productivity, offer the best possible prices and improve services. Competition was all the stiffer since it developed on a market where energy conservation removed any prospect of growth with respect to overall needs. It must also be pointed out that on the industrial heating market, there was particularly strong competition in Québec for "low-temperature heating". On this portion of the market, indeed, distributors were able to offer low-cost energy (surplus energy and dual energy by Hydro-Québec, interruptible gas by natural gas distributors, heating-oil spot sales).

Changes expected in the years to come are already fairly well known. Based on analyses presently available, it is estimated that the relative importance of each of the three sub-markets should continue to change, fol-

Graph 5
Energy Consumption in Québec by Types of Use
1971 - 2006



Source: Direction générale de l'analyse économique et financière du ministère de l'Énergie et des Ressources du Québec.

lowing trends observed in the past few years. Thus, the transportation market would retain its relative importance, while traditional electricity uses would continue to grow. All in all, by 2006, these two markets together would account for 55% of the energy requirements of Quebecers, compared to 45% for the heating market.

On the transportation market and on that of the traditional uses of electricity, no change in the present situation is forecast as regards the roles of petroleum products and electricity. In both cases, these two forms of energy should continue to dominate those markets.

However, on the heating market changes are expected that, for the most part, have already begun. Part of the heating market has indeed been captured by electricity through the continued use of electric radiators by residential consumers. For these consumers, it would now be very expensive to contemplate replacing electricity by oil and gas, since the costs involved in replacing electric radiators by a central heating system would be prohibitive. The development of gas radiators by natural gas distributors could change this situation, but the actual unavailability of natural gas in many residential zones reduces such a possibility. It is estimated that these consumers represent about 10% of the heating market and 5% of total energy demand. This share of the market will increase in the next few years with the continued penetration of electricity in the residential sector.

The responsibility that this phenomenon places on public officials, who must protect consumers in their relations with the electricity producer and distributor, should be underscored immediately. However, this phenomenon has increased and will continue to increase the relative share of markets controlled exclusively by electricity. Hydro-Québec will thus be able to rely on the existence of a stable and growing market to develop Québec's hydroelectric potential.

According to analyses presently available, the remainder of the heating market should continue to be competitive. In particular, the relative situation of oil, natural gas and electricity will depend largely on the ability of these energy forms to respond to actual needs covered by the sale of surplus electricity and interruptible natural gas. In 1986, it became apparent to what extent a variation in the competitive position of energy forms — in this case, the drop in oil prices — could quickly affect the sales of each distributor. This is a fortunate situation: the requirements in question correspond for the most part to demand from energy- intensive industries — mainly exporting industries — which are themselves subject to international competition. The highly competitive character of the energy market to which they belong is for them a guarantee of effectiveness and cost reduction.

A More Efficient Use of Energy

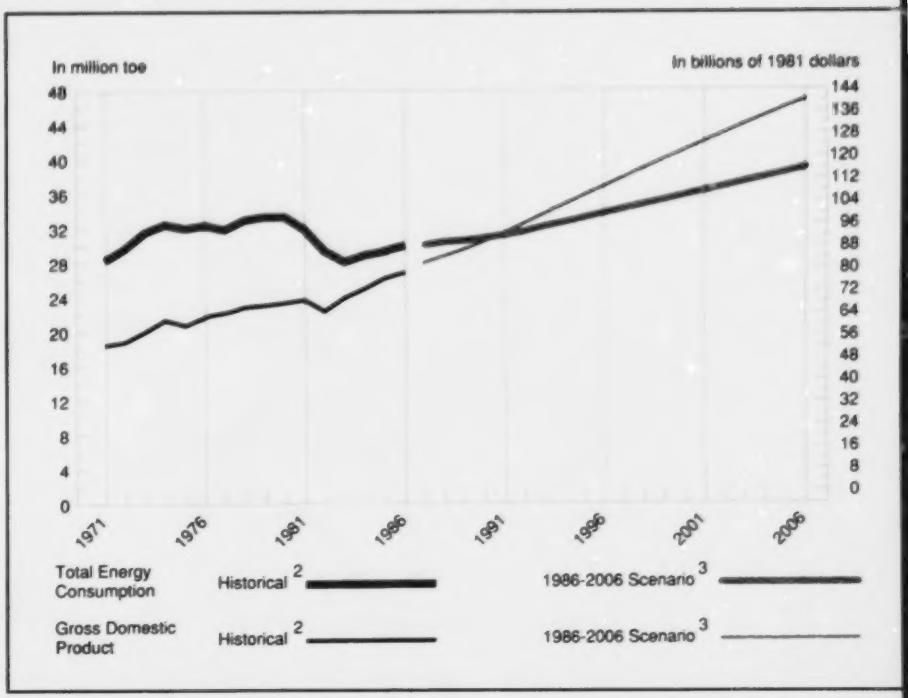
This concern for efficiency, now more than ever a priority since economies are increasingly internationalized, applies equally to the entire energy market. It is easy to see that Quebecers make better use of energy in 1986 than in 1971, and that this improvement of their "energy productivity" is precisely another characteristic of the past fifteen years. Until 1970, it was thought that the growth of economic activity was necessarily accompanied by an increase in energy requirements since an almost automatic correspondence existed between increase in wealth, measured in monetary terms, and increase in the quantity of energy consumed. Since 1971, this relation has broken down. Between 1971 and 1986, Québec's gross domestic product soared more than 50% in constant dollars while, in the same period, total energy con-

sumption inched up by a mere 4%. Thus, in 1986, to produce an equal amount of wealth, the Québec economy used 30% less energy than in 1971. A similar breakup of the historical relationship between economic growth and energy demand was found in all industrialized countries. Obviously, it must be attributed to the energy crisis, the price hikes that accompanied it and the various adjustments that consumers then made in their use of energy.

More specifically, the brutal change in the conditions of energy supplies, early in the 1970s, resulted in a number of phenomena whose global impact we are now assessing. In practice, following the energy crisis, consumers showed three types of reactions. These reactions were all caused by the desire to reduce the energy bill: first of all, consumers changed their behavior — closely watching their thermostat, managing their heating requirements in a thriftier fashion, reducing speed on the road. Consumers then acted on equipment that required energy to operate, to make it more efficient. They insulated their houses more adequately, bought more fuel-efficient automobiles or, as with enterprises, introduced processes and equipment that consumed less energy. Finally — and this phenomenon is particularly important for Québec — they replaced some forms of energy (petroleum products) with others (electricity, natural gas) that are naturally more efficient or permit the installation of more efficient equipment.

Some of these reactions have led to a redefinition of the notion of "useful energy requirement", that is, the energy required by a consumer to meet a need or carry on an activity related to a particular use. This is the case, for example, of phenomena that have affected consumer behavior. The substitution of one energy form for another and the installation of more efficient equipment has had an impact on end-use energy demand,

Graph 6
Québec's Energy Consumption [1] and Gross Domestic Product
1971 - 2006

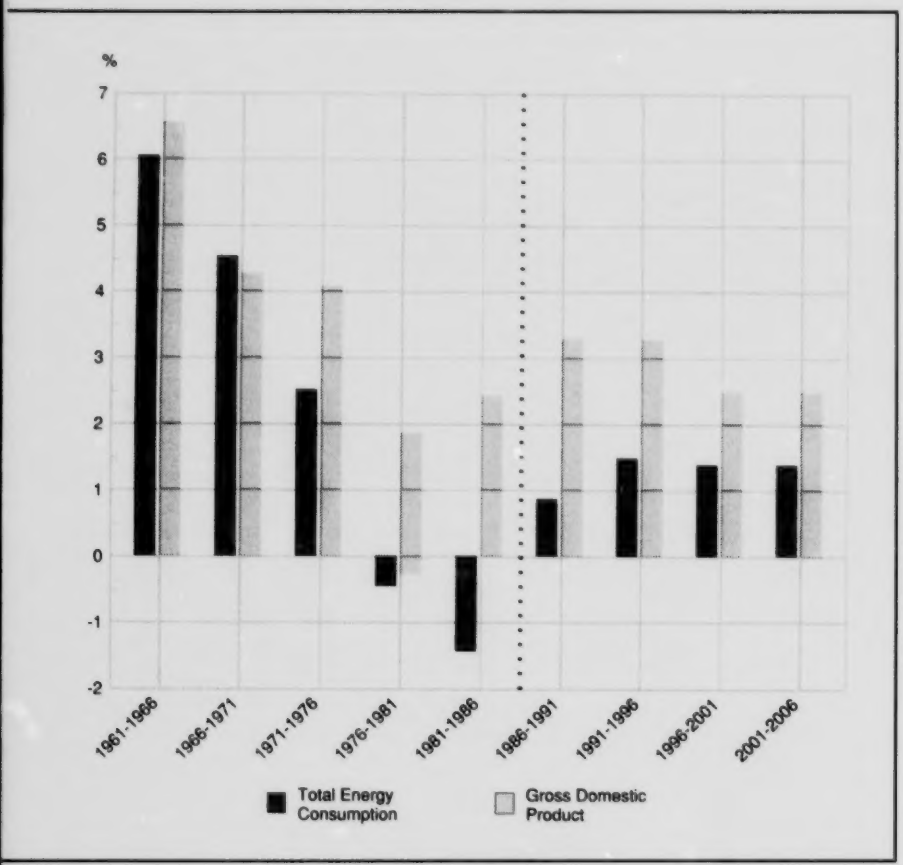


1. Excluding non-conventional energy forms.
2. Source: **Energy in Québec,** 1987 Edition.
3. Source: MÉDÉE 3 - Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006,** October 1987.

which corresponds to the quantity of energy actually required, considering the efficiency features of the equipment and of the form of energy used.

It is difficult to give even a rough figure to the relative importance of each of these three factors in the overall improvement of energy productivity in Québec, based here on end-use energy demand. A look at the facts, however, gives a few hints. It is known that, early in the 1970s, changes in consumer behavior had an immediately felt impact on energy consumption. To be lasting, this in-

Graph 7
Growth of Québec's Energy Consumption[1] and Gross Domestic Product
1961 - 2006



1. Excluding non-conventional energy forms.
Sources: **Energy in Québec**, 1987 Edition, and MÉDÉE 3 . Scenario 3, **Scenarios for End-use Energy Demand in Québec: 1986 - 2006**, October 1987.

Useful energy

The energy contained in energy products consumed by the final user, not including losses incurred when using facilities designed for these energy products.

End-use energy

The energy contained in energy products consumed by the final user, including losses incurred when using facilities designed for these energy products.

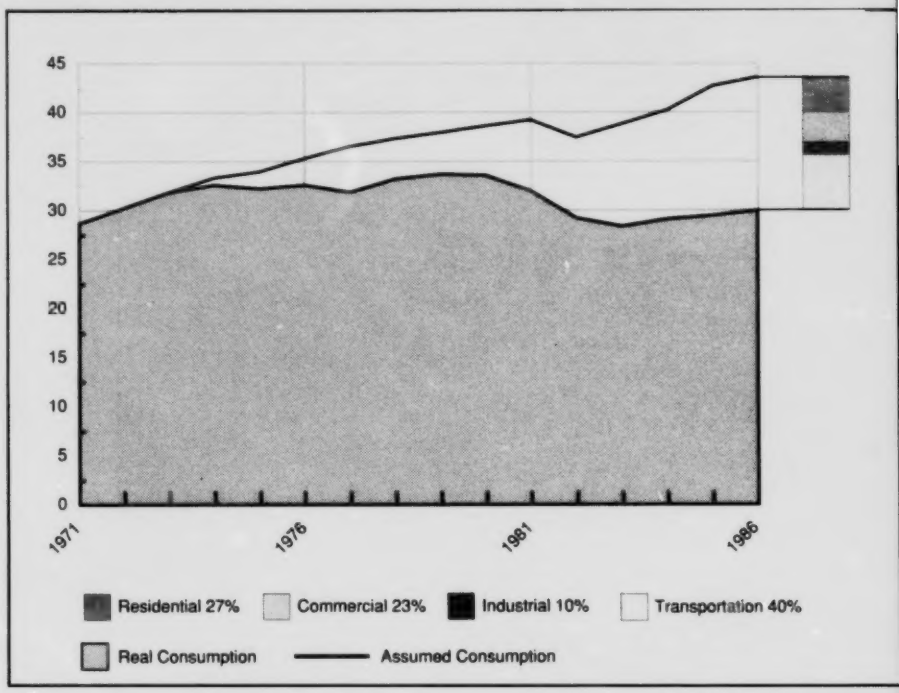
fluence needed to be backed by appropriate education and information, or by a more coercive framework. Coercion is what occurred in the transportation sector where stricter standards enacted with respect to speed limits forced drivers to adopt more energy-conserving habits. On the heating market, in the institutional sector (hospitals, administration, schools), in major businesses and large buildings, the rising awareness of managers led consumers to conserve energy: in this respect, government efforts to inform and train people played an essential role.

In Québec's case, it is probable, however, that the visible improvement in energy efficiency is due primarily to the transformation of equipment and the substitution of less efficient energy forms by more efficient ones. A few figures help measure these two phenomena: with respect to equipment, for instance, heating a 100 m^2 one-family home in compliance with the insulation standards then prevailing, required, in 1971, slightly less that 22,000 kWh of energy. In 1986, heating the same house according to the insulation standards suggested by Hydro-Québec since 1981, required only 14,000 kWh, or a drop of 40%. In the transportation sector, a typical automobile on the road in 1971 consumed 18.8 liters per 100 km. Fifteen years later, a typical vehicle among those on the road in 1986 consumed only 12.5% per 100 km, or 34% less.

The substitution of petroleum products for electricity or natural gas also had spectacular effects in terms of end-use energy demand. In single-family homes, replacing the oil heating system, which was often obsolete compared with electrical systems, reduced end-use energy requirements for heating purposes by 30% to 40%. In the industrial sector, again with respect to heating, the mere switching over from heavy oil to electricity had the effect of reducing the energy requirements of boilers by 10%.

On the whole, it appears that it is on the heating and transportation markets that Québec has made the greatest gains. It is estimated that, in 1986, had the unit consumption of each sector not been changed with respect to what it was in 1971, end-use energy demand would have been 45% more, or 13 million toe higher. Two-fiths of this sharp decline in end-use demand is attributable to the transportation sector and nearly 30% to the residential sector, the remaining being attributable to the commercial and industrial sectors.

Graph 8
Share of Each Consumption Sector in the Improvement of Energy Efficiency in 1986, Compared to 1971

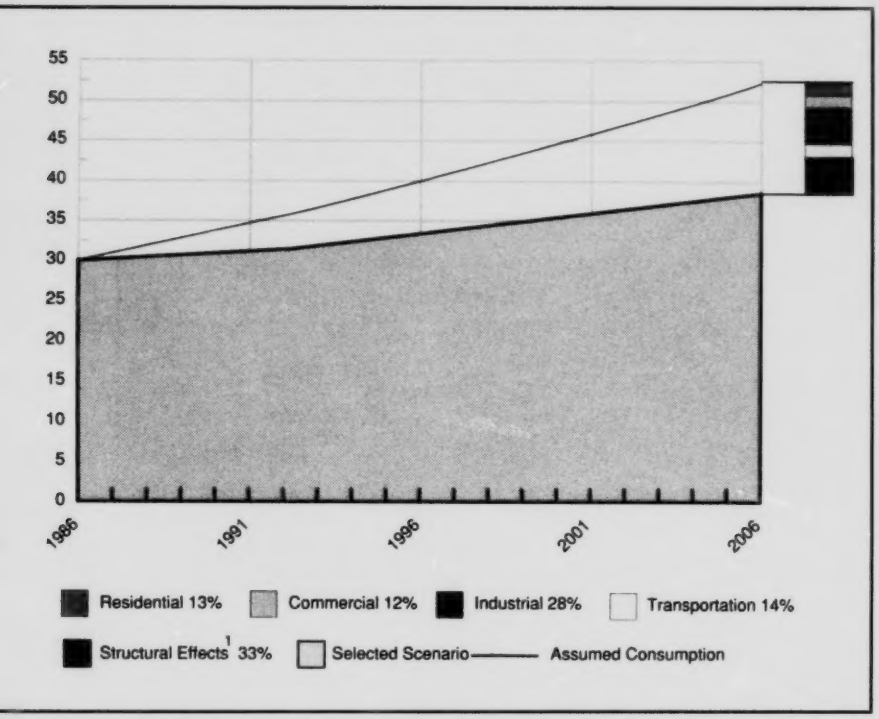


Source: Direction générale de l'analyse économique et financière of the ministère de l'Énergie et des Ressources du Québec.

Although we have gone, since the late 1970s, from a context of high energy prices to a situation of much more moderate ones, it is not expected that the conditions that led to a better use of energy will be reversed. Much to the contrary, analysts today are suggesting that, in Québec, improvement in energy productivity will continue over the next twenty years, even if there is a limited price increase of crude oil. According to these analyses, and if the calculations made for the previous period are repeated for the next twenty years, the level of the end-use energy demand expected by 2006 should be amplified by 14 million toe, or 35%, if the present characteristics of the unit consumption of sectors are kept. Again according to these analyses, the "untying" of economic growth from increase in energy requirements would be confirmed since a rise of 30% of total energy demand would correspond to an increase of 77% of the gross domestic product (GDP) in constant dollars.

These evaluations should not come as a surprise. The phenomena triggered by the energy crisis are to a great extent irreversible, at least in the medium term, and the Québec economy should thus continue to benefit from it. In particular, important productivity gains are still expected in the transportation and residential sectors. In the transportation sector, the continued improvement of the automobile stock, which will continue into the early 1990s, by itself explains at least one-sixth of the efficiency gains expected in total end-use energy demand. For there remains a gap between the average consumption of the vehicles still on the road and the performance of the new models offered in showrooms. Thus, in 1985, the new cars offered on the market consumed an average of 10.6 liters per 100 km, or 15% less than the typical vehicle on the road that same year. In

Graph 9
Share of Each Consumption Sector in the Improvement of Energy Efficiency Fore cast for 2006, Compared to 1986



1. Structural effects based on the slowing of demographic growth.
Source: Direction générale de l'analyse économique et financière of the ministère de l'Énergie des ressources du Québec.

the residential sector, demographic change will be added to the appearance of new, better insulated housing on the market and to the continued replacement of oil by electricity to explain the stabilization of energy demand.

The changes expected in the industrial sector are perhaps the most interesting of all. On the whole, nearly 30% of the improvement in energy efficiency expected by 2006 will come from the industrial sector. The latter would thus play a much greater role than in the past with respect to overall energy efficiency. A still more remarkable phenomenon, this better use of energy would accompany the sustained growth of energy-intensive industries, particularly those of aluminum and pulp and paper.

These results are explained by the expected improvement of energy productivity in industry. For the industrial sector as a whole, energy consumption per thousand dollar output should fall by more than 20% between 1986 and 2006. In energy-intensive industries, production gains would have a marked effect on the overall demand of the sector: per ton produced, energy consumption would thus drop 17% in the aluminum sector and 18% in the cement sector.

The penetration of "electrotechnologies", a phenomenon that is still improperly measured, could have a considerable impact: electrotechnologies are new electric processes that use, for example, both induction and infrared techniques, which are likely to replace, especially in the pulp and paper industry, a certain number of processes actually using fossil fuels. Given the strong energy performance of these technologies, introducing them would have a significant effect on the energy consumption of the whole sector. Thus, according to the actual assumptions used, electrotechnologies would explain 7% of industrial electricity demand by 2006 and then replace 20% of the sector's oil and gas consumption.

The more efficient use of energy has had very positive effects on the Québec market. Transposed to 1986, the consumer habits that prevailed in 1971 would have increased society's energy bill by nearly three billion dollars. The outlook that has just been presented shows that there is still much room for improvement in energy efficiency, especially

in the industrial sector. This potential must be realized if we wish to maintain and improve the ability of our enterprises and our economy to compete.

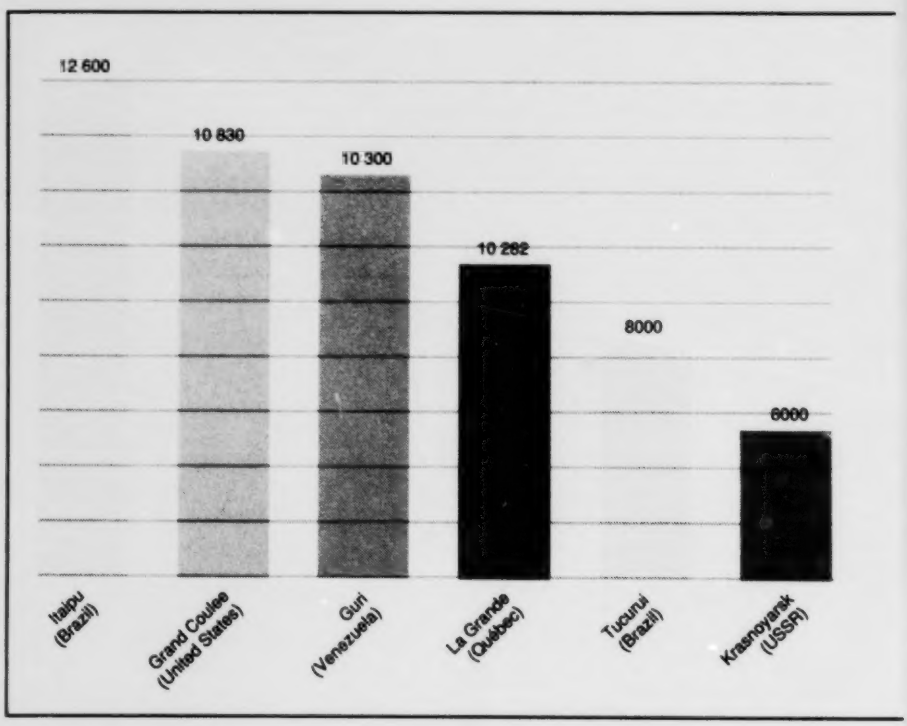
Abundant Energy Resources

To meet its energy requirements, Québec has access to abundant resources: direct access on its own territory, with respect to the wealth of hydroelectric resources and certain non-conventional energy forms; and access within Canada, by means of an important system of gas and oil pipelines linking Québec distribution centers to western deposits. The presence of these resources is obviously an essential element of the Québec energy context, and it must be fully utilized in the development and growth policy selected by the government.

Québec, Fourth Largest Hydroelectric Power Producer in the World.

Québec has been blessed with a huge watershed that is ideal for hydroelectric development. This opportunity has been seized: since the first half of the twentieth century, considerable efforts have been expended to develop this resource. Dams have been constructed, transmission lines have been laid. The province's abundant hydroelectric resources have thus been developed and utilized. The acceleration of this development effort is one of the remarkable phenomena of the past fifteen years. Toward the end of the 1960s, Québec was already the leading hydroelectricity producer in Canada. Between 1971 and 1986, Hydro-Québec's installed power more than doubled, jumping from 11,000 MW to 24,000 MW. The huge James Bay development projects alone have added 10,000 MW to Hydro-Québec's production network. On a territory that is one-third the size of France, Hydro-Québec has built, in thirteen years, the fourth largest hydroelectric complex in the world. To transport and distribute this electricity, Hydro-Québec has set up an extremely complex transmission and distribution network. The transmission network alone consists of 30,000 km of circuits, which makes its one of the largest in North America.

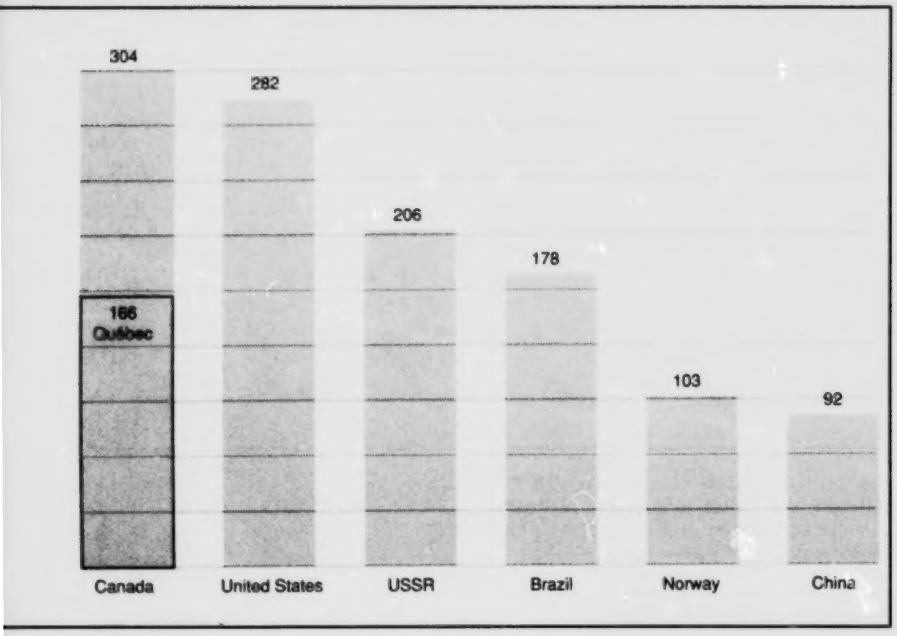
Graph 10
Major Hydroelectric Complexes in the World (in MW)
1986



Sources: International Water Power and Dam Construction, and Direction générale de l'analyse économique et financière of the ministère de l'Énergie et des Ressources du Québec.

Thanks to Québec resources, Canada ranked first in 1985 among hydroelectricity producing countries. If we consider all the hydroelectricity available at Hydro-Québec and at private producers in the province, Québec alone was, in 1985, the fourth largest hydroelectricity producer in the world behind the United States, the USSR and Brazil. Québec alone controls 8% of the world's hydroelectricity, 28% of North America's and 54% of Canada's.

Graph 11
Major Hydroelectricity Producers in the World (in TWh)
1985



Sources: **Statistical Yearbook**, United Nations, and ministère de l'Énergie et des Ressources du Québec.

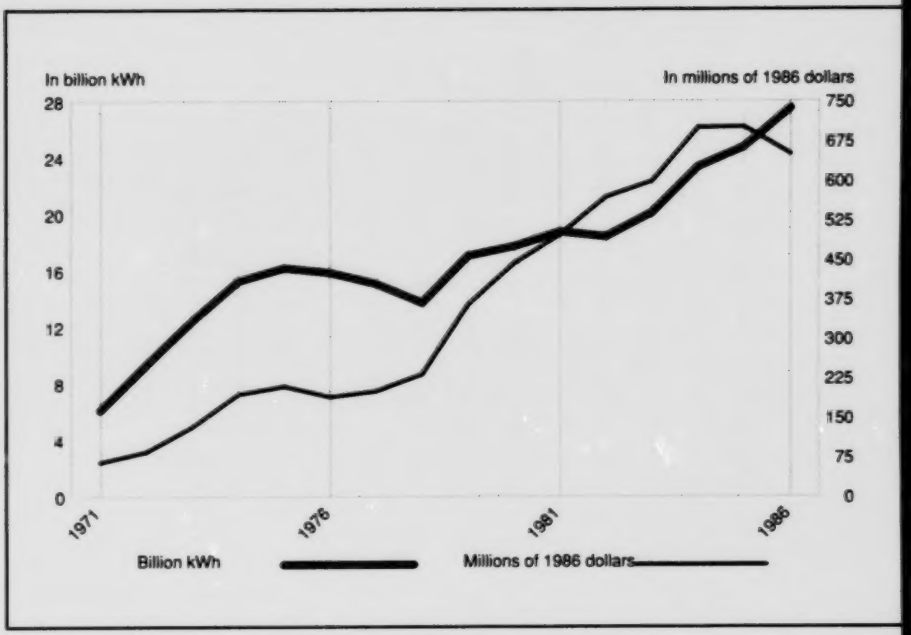
The fact that hydroelectric energy is renewable obviously confers exceptional value upon this energy resource. Another remarkable phenomenon is that Québec is far from having exhausted the hydroelectric potential capable of being developed. The potential that remains to be developed is assessed at close to 40,000 MW, or 200 TWh, three quarters of which correspond to sites whose rate of flow and height will yield an output of more that 100 MW. Of this total, the potential already economically viable is estimated at 18,000 MW, or 95 TWh, but this is probably a conservative estimate that could be significantly increased.

The existence of this potential is a major asset for Québec. The latter is in effect one of the last industrialized regions of the world to still possess considerable unused hydroelectric resources. These are equal to the total hydroelectric potential that could still be developed in the eighteen European countries of the Organization for Economic Cooperation and Development (OECD). Furthermore, to support the development of this potential and justify it economically, Québec can rely on both a dynamic domestic market, where growth reserves are not exhausted, and export markets, where considerable needs remain. Thus, the electric power requirements that the New England states and the State of New York must meet by the end of the century are estimated at 12,800 MW.

The increase and intensification of electricity exchanges between Québec and its neighbors are yet another characteristic of the past five years. Between 1971 and 1986, the quantities of electric energy sold by Québec on external markets were multiplied by 5, and export revenues by 9. In 1986, Québec thus sold to other Canadian provinces and to the United States nearly 27 billion kWh of electricity, and its export receipts totaled 650 million dollars.

The contracts recently concluded with Central Maine Power (CMP), the New England Power Pool (NEPOOL), the New York Power Authority (NYPA) and the Vermont Department of Public Service will mean a new advance in Québec electricity exports. To ensure them, Hydro-Québec will reinforce the existing interconnection network. On December 31, 1986, this network already had a total transmission capacity of slightly over 6,000 MW.

Graph 12
Electricity Sales on External Markets
1971 - 1986



Source: **Energy in Québec**, 1987 Edition.

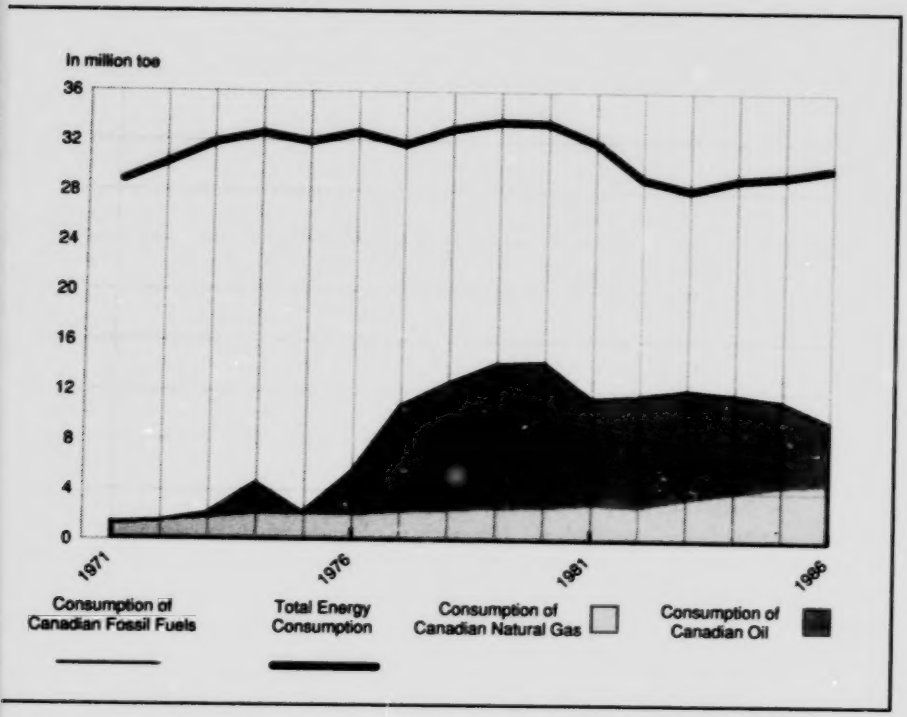
Using Forest Resources to Produce Energy

Hydroelectricity is not the only abundant source of energy on Québec's territory. Québec also boasts important forest resources, which have always helped meet energy requirements. This contribution was considerably reduced with the penetration of coal, and then of petroleum products on the heating market. Since the energy crisis, there has been an important return to wood and forest waste on certain specific markets.

In the industrial sector, the pulp and paper and lumber industries have turned to using more residues in their operations to cut their energy bill and improve the security of their supplies, while raising the overall efficiency of their activities. In fifteen years, the use of biomass for the energy requirements of the industrial sector has thus slightly more than doubled. It actually represents close to 2 million toe. In this sector, the future use of forest biomass as a source of energy will remain closely tied to the production level of pulp and paper plants and sawmills. These production levels will themselves strongly depend on the overall availability of the forest resource. It is estimated that, in the medium term, the availability of this resource should continue to increase, but at a slower rate than in recent years. However, in some cases, technological change will contribute to a more complete use of forest biomass as raw material and therefore to a proportionately smaller production of residue for energy use.

In the residential sector, where the other large forest biomass market is found, the situation is somewhat different. There too, wood has made a spectacular comeback following the energy crisis. In fifteen years, wood consumption doubled in the residential sector, reaching one million toe in 1986. Wood heating systems have appeared on the market and distribution and marketing networks have cropped up in cities and towns as well as in rural and forest regions. Forest biomass has thus captured a share of the residential market, either as main heating system or as backup system.

Graph 13
Share of End-use Energy Demand Met by Canadian Oil and Gas
1971 - 1986



Source: Direction générale de l'analyse économique et financière of the ministère de l'Énergie et des Ressources du Québec.

Contrary to the industrial sector, the increased use of wood on the heating market is not linked to a problem of resource, but rather to a question of price. The increased penetration of wood into the heating market presupposes the high price of conventional energy forms. In this context, considered the most probable at the present time, where prices will rise moderately, this increased use of wood will only be a limited one. This does not lessen interest in the energy potential of forest resources: an important and accessible potential exists, and many residential consumers could have recourse to it on short notice. Thus, in the residential sector, the forest potential must be considered as additional security, to which one might have recourse in certain regions where supplies of conventional energy forms may be difficult to obtain.

Access to Canadian Fossil Fuel Resources

In the early 1970s, Québec used natural gas only marginally. It imported from the world market all the oil it consumed. In 1986, the situation was altogether different. The construction and expansion of natural gas and oil transportation networks, the setting up of natural gas distribution networks, and grants from the various levels of government to support the penetration of natural gas, have considerably changed Québec's energy supply system. Québec was finally granted effective access to the wealth of fossil fuels from western Canada. In 1986, Canadian oil and gas together ensured 32.4% of Québec's end-use energy requirements, compared to only 4.9% fifteen years earlier.

This new situation produced very positive results. The effective availability of natural gas, for which Québec had applied for many years, reinforced security of supplies, increased the possibility of choice offered consumers and made available to most regions an energy source that is both efficient and environmentally quite safe. As for oil, the replacement of an important share of our purchases on the world market by imports of Canadian oil also reinforced the security of our supplies, ensured greater diversity and provided a source of very good quality light oil. In both cases, Québec paid a much larger part of its energy bill in Canadian currency, which benefited all of Canada with respect to trade and the balance of payments. In addition to the increased use of hydroelectricity, access to Canadian fossil fuel resources allowed Québec to significantly strengthen its energy self-sufficiency.

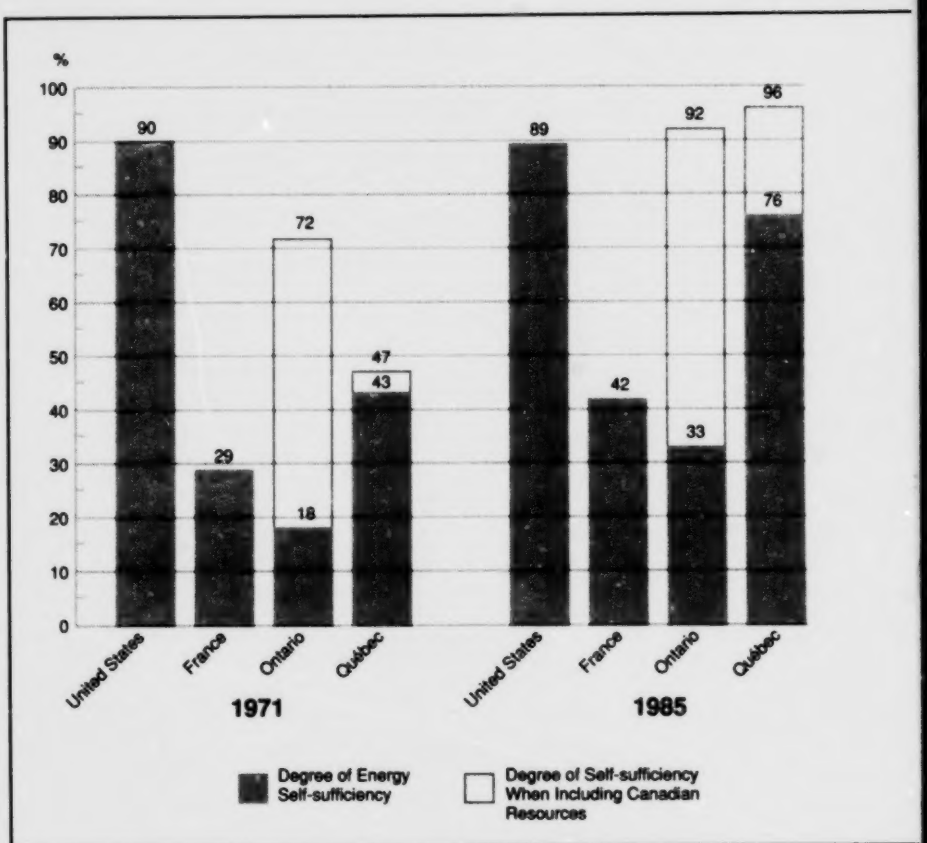
Such a change in the sources of supply was carried out only at the cost of considerable investments and, as regards the penetration of natural gas, with the help of programs financed and supported by governments and distribution companies. Regular access to Canadian oil was made possible through the construction of an oil pipeline between Sarnia and Montréal, decided upon by the federal government following the energy crisis. As for natural gas, it is estimated that slightly more than 1.6 billion dollars overall were spent in Québec for transportation and distribution between 1980 and 1985.

Above all, the delivery of a fraction of western natural gas and oil to Québec markets could be carried out successfully only in a favorable context, which presupposed in particular that, with regard to western exports, a clear priority had been established in favor of Canadian consumers.

Concerns on the Gas Market

This context has now changed, and certain concerns are beginning to appear with respect to Québec's future access to western fossil fuel resources. The reason for these concerns can be easily explained. Regarding natural gas, the problem does not stem from the magnitude of Canadian reserves available for consumption. These reserves are quite considerable. In 1986, Canada ranked third among world producers of natural gas, behind the United States and the USSR. On December 1986, proven reserves in Alberta, British Columbia and Saskatchewan — that is, reserves that are economically usable in actual conditions — stood at 98.8 thousands of billions of cubic feet (10^{12}), or 40 times the consumption and exports of 1986. If we add to these reserves the volumes that could be obtained by undertaking some exploration and development work, as well as economically unprofitable fields, the reserves that are not yet discovered, and those of the "frontier" regions (Mackenzie Delta, Beaufort Sea, Arctic Archipelago, the eastern and western continental shelves), we can easily multiply by five the importance of Canadian gas fields.

Graph 14
Québec's Energy Self-sufficiency[1] Compared to that of Some Industrialized Countries and Ontario
1971 - 1985



1. The degree of energy self-sufficiency has been calculated with respect to primary energy (by dividing domestic energy production by energy requirements) taking into consideration secondary energy exchanges with external partners. For primary energy, and regarding electricity in particular, OECD rates of conversion were applied.

Sources: OECD, **Energy Balances of OECD Countries, 1970 - 1985,** Paris, 1987, and Direction générale de l'analyse économique et financière of the ministère de l'Énergie et des Ressources du Québec.

Quite obviously, all these fields are not equally accessible. No significant contribution from the reserves of the Arctic or the North is expected before the turn of the next century, while operations at gas fields off the east coast (Sable Island and Hibernia) could begin in the 1990s. It has been noted, however, that Canadian gas reserves are quite sufficient, in the short and medium terms, to meet domestic needs — including those of Québec — in addition to meeting a substantial part of American needs.

Present-day concerns have to do with the price these volumes will post and how difficult it will be for Québec distributors to compete with other forms of energy, that is, oil and electricity. Beginning in the mid 1980s, the federal government, supported by the producer provinces as well as by Québec, proceeded to deregulate the fossil fuel sector. In the natural gas sector, this move was aimed at deregulating prices and establishing true competition between producers so that, across Canada, distributors could meet the competition.

Deregulation has had very positive effects for producers, distributors and consumers. Since 1985, the price of natural gas shipped to Montréal has fallen slightly, while it had multiplied by four during the previous decade. In Québec, distributors were thus in a position to hold on to their markets despite competition from oil, prompted by the drop in world prices, and from electricity. They even made inroads into new uses, thus guaranteeing the medium- and long-term development of the sector.

However, the deregulation of the fossil fuel sector has also entailed the deregulation of trade on foreign markets. With respect to the natural gas trade, this deregulation has meant the creation of a truly North American space, a forerunner — in the gas sector — of the Free Trade Agreement with the United States. Québec believed that such deregulation should be viewed with caution, given the magnitude of the American market, its future needs and the effects that changes in the American situation could have on the price of natural gas in Canada. As Québec hoped, the Free Trade Agreement concluded between the United States and Canada explicitly provides that, should difficulties of supply occur, the Canadian government may establish "surplus tests", that is, a control on quantities slated for export. This security measure was necessary, given the impact upward pressure on the American gas market could have on the price of gas sold in Canada. Gas consumption in Québec would doubtless be the first to be affected by such pressures.

Concerns About Oil Supplies

As regards Québec's access to western oil resources, concerns focus on the very availability of the resource. Canadian oil production grew very rapidly during the 1960s, then stabilized at about 1.6 million barrels per day. In 1986, however, oil production rose somewhat and stood at 1.8 million barrels per day (for an output capacity of 2.1 million barrels per day), making Canada the ninth largest producer in the world. According to the latest projections of the National Energy Board (NEB), there should be a significant decrease in the supply of Canadian crude over the next twenty years.

If we take the most probable scenario, Canadian output capacity would drop 15% by the turn of the next century and reach 1.8 million barrels per day. This decrease would be due, in practice, to a drop in the production of light oils, whose share of total production would slide from 80% to slightly more than 50%. It is light oil that constitutes the bulk of the supplies of Québec refineries. The rapid reduction of the capacity to produce light

crude oil stems basically from the decline of oil reserves in the classic regions, a drop that would be only partially compensated by an increase of supplies from frontier regions (Beaufort Sea and Hibernia), by synthetic oil from tar sands, and by light oil obtained by upgrading heavy oil.

Because of its position at the end of the oil pipeline network that distributes Canadian oil, Québec would be the first to be affected by the decline in Canadian supplies. According to numerous forecasts based on NEB evaluations, beginning in 1995 Québec would depend on the international market for all its energy requirements. There would thus be a complete reversal of the present situation and a return to conditions prior to 1976. Since operations at the Hibernia deposit would reduce the Atlantic provinces' dependence on world markets by the end of the century, Québec could then well become the only region totally dependent on international oil and thus turn into a veritable enclosure in the midst of the Canadian market.

There is nothing theoretical about these concerns. For the past few years, there has been a drop in the relative share of Canadian oil in our oil supplies. This share has recently fallen sill further. In 1986, western oil represented 40% of our purchases of crude, compared to 60% three years earlier. The viability of the Sarnia-Montréal oil pipeline is now threatened. Designed to carry 300,000 barrels of crude oil per day, it carried only 130,000 barrels per day in 1986.

A number of strategies have been proposed so that, in a first phase, the Sarnia-Montréal pipeline will continue to operate, then long-term measures would be applied to correct the projected changes in Canadian supplies. It is indeed probable that the development of the deposits in frontier regions (Beaufort Sea) will be, after the year 2000, in a position to offset the light oil deficit expected in the medium term and to meet the requirements of the Québec market at least partially. Until then, maintaining a permanent link providing access to Canadian oil is very important for Québec. Establishing this link led to a structural change in the crude oil supply system. To eliminate it would significantly alter this system.

Consolidating the Refining Industry and Supplying the Petrochemical Sector

In the oil sector, one of the concerns is obviously the evolution that occured in the Québec refining sector. In 1971, the installed capacity for processing crude oil in Québec reached close to 600,000 barrels per day and represented a third of Canada's entire refining capacity. Fifteen years later, this capacity was only 300,000 barrels per day and the relative share of the Québec refining sector in Canada had plunged to 15%.

Following the sharp drop in the market's oil requirements, the decline of the crude oil processing capacity was inevitable. However, it is certain that this reduction has gone beyond what was desirable. In fifteen years, crude oil processing capacity plunged nearly 50%, while demand for petroleum energy products fell slightly less than 40%. In 1986, Québec found itself more dependent on foreign sources than it had in 1971 with respect to meeting its requirements in petroleum products. This dependence is particularly true concerning gasoline and petroleum coke. Besides contributing to a major loss of activities for the Québec economy, the decline of the refining sector also led to the deterioration of our petroleum products trade balance.

The elimination of part of the refining capacity directly affected the petrochemical sector. In Québec, the petrochemical industry was

built on the availability of oil-related feedstocks (naphta and distillates) obtained from various refineries. The shutdown of some of these refineries has led to serious supply problems for a sector that is already confronting other difficulties.

In recent years, Petromont has undertaken to replace some of these oil-related feedstocks by natural gas liquids (NGL) in order to improve the flexibility and diversification of its supplies. Although NGL are readily available in western Canada, to succeed, this operation requires that the transportation cost of NGL to Montréal be significantly reduced. Indeed, NGL from western Canada cannot at the present time be delivered to Montréal profitably. The Soligaz project, which Québec strongly supports, is aimed precisely at setting up a permanent and economical supply system by adapting the Sarnia-Montréal oil pipeline to carry NGL. The operation would both ensure supplies to the Montréal petrochemical industry at economical conditions, and keep the transportation system linking Québec refineries to western oil deposits in operation.

As concerns refineries, the question could be raised as to whether the decline experienced since the 1970s will be reversed. Over the next twenty years, the oil requirements of Québec consumers should grow only slightly. However, for the refineries, the mere return to a situation of self-sufficiency would significantly increase the importance of domestic outlets. When one adds that many promising export markets remain to be explored — those of New York State and New England, in particular — one finds that there are real possibilities of eventually increasing the use of refineries and boosting existing refining capacities.

An Essential Place in the Economy

The energy sector occupies an essential place in Québec's overall economic system. What is more, Québec very likely has in the energy sector some of the most promising instruments of its future development.

The place of energy in Québec's economy is easy to illustrate. Overall, the energy sector represents an important part of the total economic picture. Thus, in 1986, energy expenditures constituted 10% of Québec's gross domestic expenditures. Slightly less than 7% of the total spending of individuals was devoted to energy. In terms of gross domestic product, in 1984 the electricity sector alone showed nearly 4 billion dollars of value added, or 4.6% of Québec's total gross domestic product. In 1986, approximately 50,000 jobs depended directly on this sector, not including jobs at major energy project sites, or jobs related to the construction of such projects.

Québec's Energy Sector, a Major Source of Investments

The place of the energy sector in the growth and development of Québec is due mainly to the direct and indirect role played by energy with respect to certain key economic variables. The first obviously concerns investments. In 1987, total investments in the energy sector reached 1.8 billion dollars, or 8% of the overall investments of the economy. This already considerable share was even larger in the past. In 1978, at the peak of the James Bay construction project, energy investments represented one-fourth of total investments, which probably constituted a sort of record for an industrialized economy.

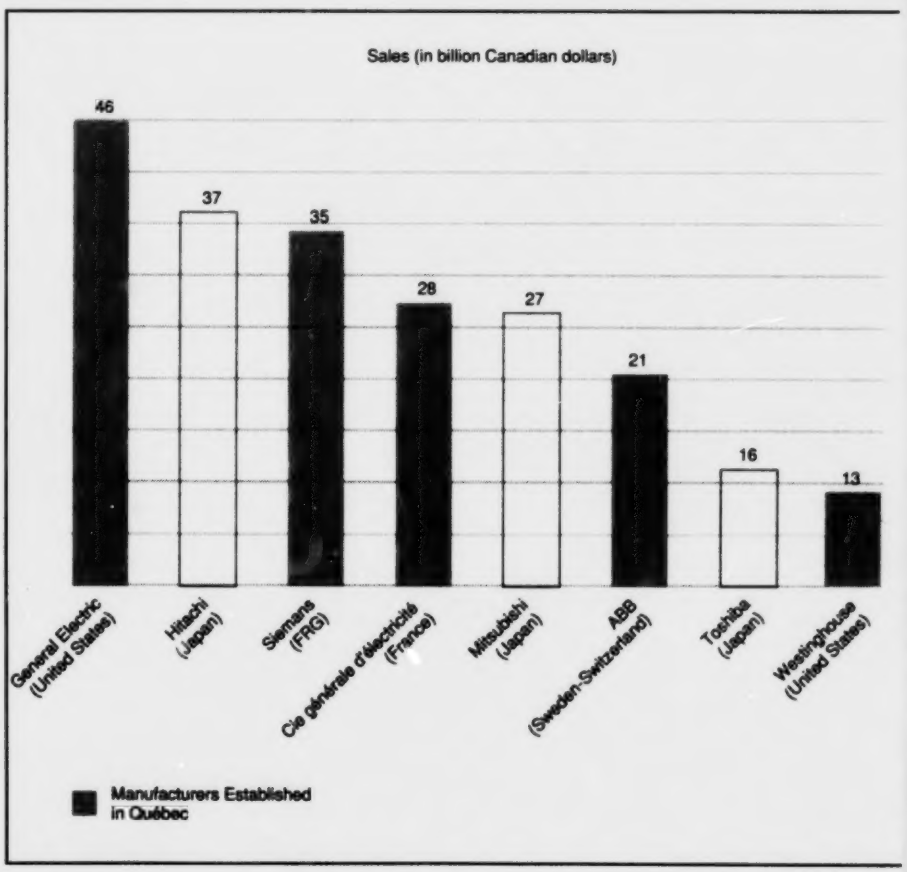
In Québec, the implementation of a number of large projects — hydroelectric development, the construction of natural gas transportation and distribution networks — stimulated growth over the years and created many jobs. Investments in hydroelectricity clearly played an important role in this area. Their development explains, to a great extent, one of the major aggregates of the Québec economy. From 1980 to 1986, these investments stabilized, then dropped significantly because of the discontinuation of major hydroelectric development projects. This deceleration has now come to an end: the launching by Hydro-Québec of important projects in the transmission network is already being felt through the overall evolution of investments. Furthermore, the resumption of the development of the hydroelectric potential, planned for the early 1990s, will constitute a new source of growth.

Energy and the Balance of Trade

Another basic economic dimension, that of foreign trade, is strongly influenced by the economic situation. In Québec, as in all industrialized importing countries, the energy crisis significantly disrupted the balance of trade and of payments. Thus, the share of crude oil purchases in total imports from abroad jumped from 9% to 22% between 1971 and 1976. It is precisely because of this considerable rise in the energy bill and of the levies on the wealth of industrialized countries this increase represented in terms of foreign currencies, that these countries set up policies to conserve energy and replace oil. In 1986, despite the progress made in Québec in these two directions, the purchase of international crude oil still represented 6% of the total purchase of goods from the world market. This shows the importance of the energy variable in any policy aimed at improving the balance of trade with foreign countries.

Québec, on the other hand, has the good fortune of also being able to use the energy sector to restore or improve its foreign trade. Indeed, the spectacular advance of electricity sales to the United States is now beginning to be felt in the trade balance. In 1986, electricity sales on the American market reached close to 380 million dollars, which represented 2% of the overall value of goods exported by the Québec economy. The implementation of recently signed contracts will increase this relative share in the coming years.

Graph 15
Major Manufacturers of Electrical Facilities in the World and Manufacturers Having a Plant or Subsidiary in Québec 1986

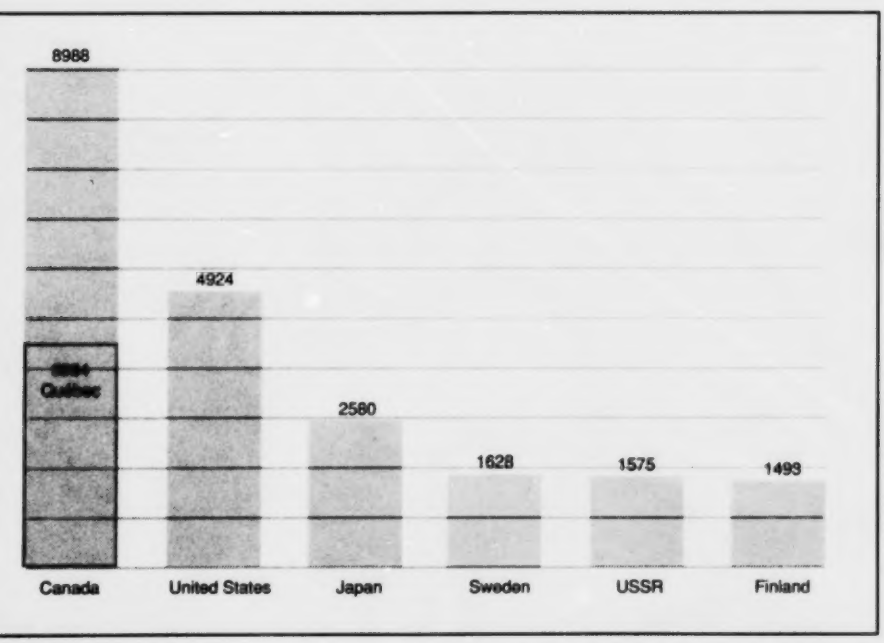


Source: Hydro-Québec.

Energy, an Industrialization Factor

The most complete measure of the place of energy in Québec's economic development is seen in its enterprises. The characteristics of the Québec energy context have influenced them in two ways. The development of the hydroelectric potential has led directly to the appearance and development of many sectors of activity that, after honing their skills in Québec, have performed on the international scene. This is the case, for instance, of the entire cable,turbine and electrical material industry, but also of engineering consulting firms specializing in the design and execution of major construction and development projects. These companies can now export their goods and services. The Québec energy context has also constituted a very strong attraction factor for certain energy-intensive industries wishing to take advantage of savings resulting from the low prices offered. At home, manufacturing companies already established in Québec have benefited from secure energy supplies at competitive prices.

Graph 16
Major Newsprint Producer Countries in the World (in thousand metric tons) 1985



Source: Québec Forest Industries Association.

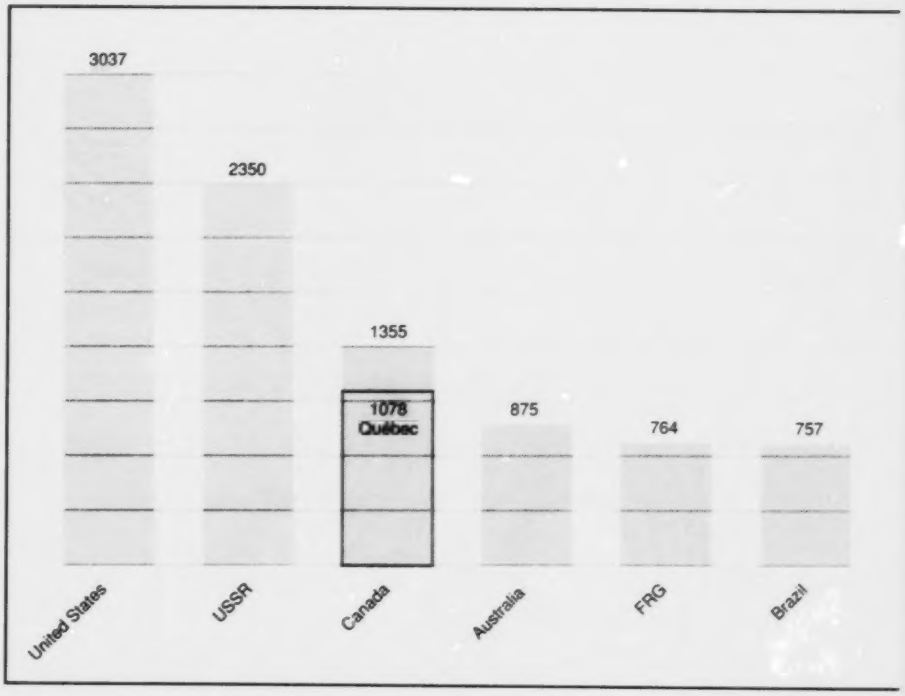
Thus, as a direct consequence of major development projects, five of the eight largest international companies producing electrical supplies (transmission and sub-transmission equipment, turbogenerating stations) have a subsidiary or one of their plants located in Québec. A great many medium-sized companies have benefited from the spinoffs generated by development projects. Managing hydroelectric projects led to the rapid development of engineering consulting firms, among which, Lavalin and SNC, are actually the two top-ranking engineering consulting firms in Canada and are listed among the ten largest firms of the kind in the world. The cases of Lavalin and SNC are, moreover, exemplary in more than one way: from their activities in Québec in the energy field, these companies have developed expertise that they now apply abroad. In 1986, 50% of Lavalin's revenues and 40% of SNC's were earned outside the Canadian territory.

As for attracting energy-intensive industries, it should first be noted that energy costs and price stability can represent for certain industries a determining factor in their ability to compete. In the Québec steel, pulp and paper, smelting, and refining industries, for example, the cost of energy in 1985 represented between 20% and 30% of the total cost of raw materials, compared to slightly less than 8% for industry as a whole. It is not surprising, then, that in these industries the availability of low-cost energy often plays a determining role in establishing and developing facilities.

In the pulp and paper sector, the existence of an important forest resource, combined with the energy advantages offered by the Québec market, explains Québec's place in the industry. In 1985, Québec thus ensured 44% of Canadian newsprint production and 14% of world production. In the aluminum sector, the world geography of production has been profoundly transformed by the rise of energy costs. An important fraction of production capacity has been transferred to major energy producers — namely, Australia, Brazil, Canada and Venezuela. Québec, which has only its electricity to offer, became the world's third largest producer in 1987 and now ensures 7% of total production, compare to 6% three years ago. This share should continue to rise in the next few years. Alcan, with headquarters in Montréal, is the world's leading aluminum producer.

In effect, the energy sector gives Québec, thanks to its hydroelectric resources, a comparative edge that must be fully exploited in international competition. It is quite remarkable that two of the three exporting industries in Québec (pulp and paper and extractive metallurgy) are energy-intensive industries, for which energy costs are crucial.

Graph 17
Major Aluminum[1] Producer Countries in the World (in thousand tons) 1986



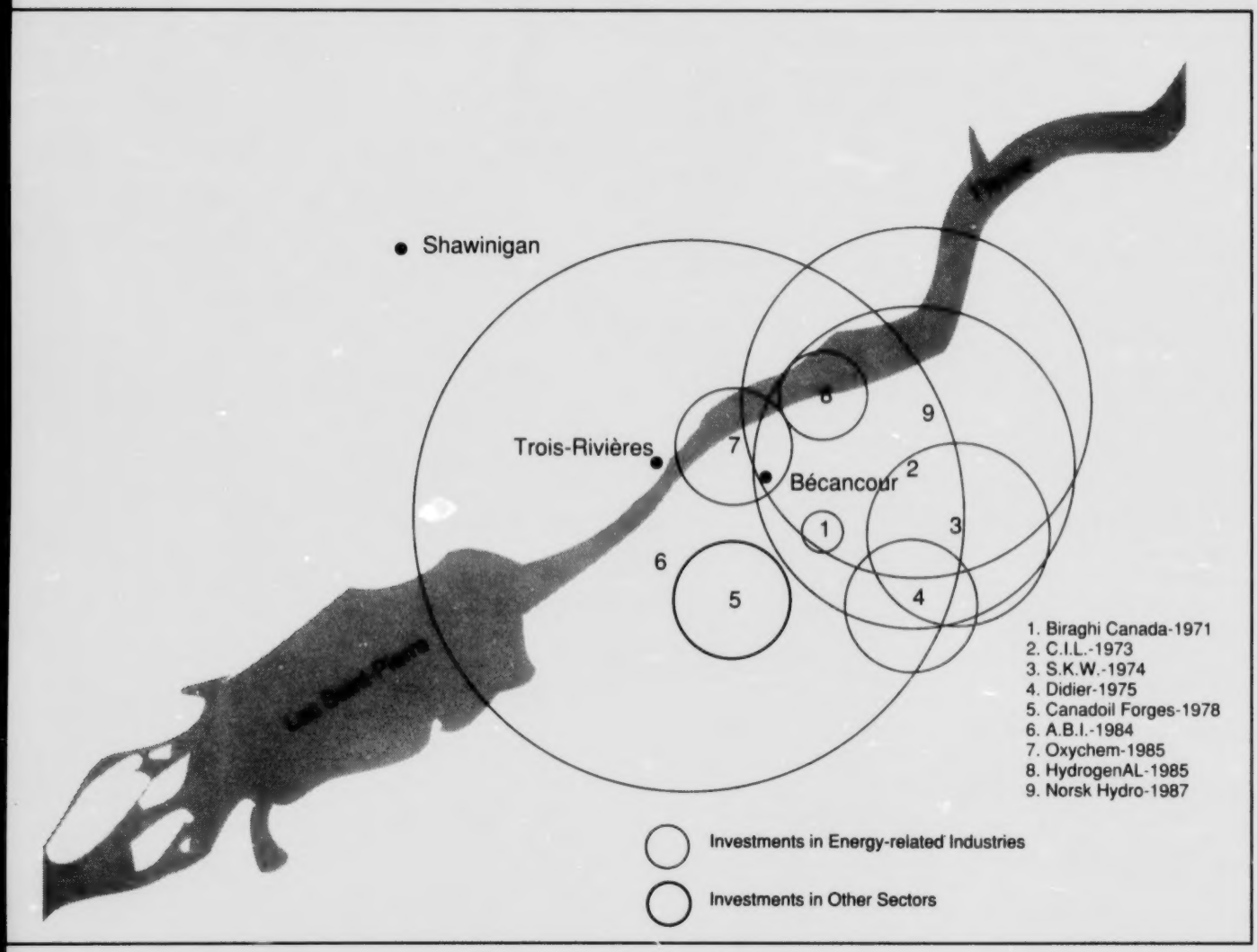
1. Primary aluminum ingots.
Source: Direction générale de l'industrie minérale of the ministère de l'Énergie et des Ressources du Québec.

Energy and Regional Development

Québec's regions are especially sensitive to the strategic place of energy in economic development, and rightly so. Construction and development activities have a direct impact on the economy of regions where these investments are made. More structurally, energy-intensive industries often represent, in these regions, the very basis of economic activity. Moreover, they constitute the greater part of industrial activities outside the Montréal region. This is especially true of the forest and mining industries.

For the regions, the availability of low-cost energy thus represents a determining factor for development. The case of the Saguenay — Lac-Saint-Jean region is a well known example. More recently, the growth of Bécancour's industrial park and harbor relied primarily on energy-intensive industries, to which the park offered the advantages sought by these firms with respect to the availability of energy sources.

Graph 18
Investments in Bécancour's Industrial Park and Harbor
in Chronological Order of Implementation



Source: La Société du parc industriel de Bécancour, March 1988.

With respect to costs and availability of electric energy, Québec's regions are on a virtually equal footing owing to an integrated electricity network over most of the inhabited territory and to a policy of uniform rates throughout the entire network.

The expansion of natural gas networks in the early 1980s made natural gas available beyond Montréal, up to Québec City and the Saguenay — Lac-Saint-Jean regions. However, rates still vary according to the geographic location of the networks. Making rates uniform would constitute an added asset for regional development. Moreover, development of the networks in zones that are already affected and expansion into new regions would allow a greater number of localities to benefit from this industry-promoting effect.

Energy and the Environment: the Emergence of a New Equilibrium

Activities related to the energy sector have an impact on our environment. The nature and importance of this impact vary according to the very content of the activities in question. Producing, transforming, transporting, storing and using energy entail changes that are more or less perceptible in the system in which we live. In some cases, the changes are negligible. In other situations, the disruptions are sometimes more noticeable. The degree of impact arising from energy-related activities also varies according to the form of energy considered. The production of natural gas does not have the same implications for the environment as that of coal or nuclear energy.

Québec's Energy Sector and the Environment

For Québec, the relations between energy and the environment obviously concern only the energy-related activities that in effect take place on our territory. Among these activities, everything that concerns electricity occupies a special place since electricity is the only form of energy where the entire process relating to its use occurs wholly on our territory, from production to consumption, and also since electricity is exported in large volumes. From an environmental point of view, the consumption of electric energy is nonpolluting and therefore does not disrupt the environment. But it is during construction (building dams, constructing basins) and transportation (laying transmission lines) that activities related to the electricity sector have an environmental impact. Basically, this influence results from the transformations brought by major development projects or by the visual and operational effect of facilities.

With respect to oil, the Québec environment is affected by refining, processing, shipping and consumption activities alike, especially because of the pollution emitted in the air as a result of these operations or the residues they leave behind. The use of fossil fuels by motor vehicles is one of the main sources of air pollution in cities. When operating, refineries and petrochemical facilities emit products that can significantly change the quality of the air we breathe. Oil transportation also, either by ship or over land, carries the important risk of spills and of polluting surrounding areas.

Natural gas also implies environmental disruptions, but to a far lesser extent than oil. The building of transportation networks raises questions of land development. In Québec, consumers are very sensitive about the use of natural gas and the potential risks

of using it. Finally, it should be noted that the Québec environment is equally affected by the use of forest biomass. Problems can surface at the moment of consumption because of polluting elements emitted in the atmosphere through the combustion of wood or forest residues.

Growing Awareness: a Recent Phenomenon

Energy-related activities alter our environment. In Québec, these changes have a specific character because of the very content of the energy-related activities that take place on our territory. This in itself is not a new phenomenon. What is new is the change of perception that the groups concerned have of the impact of these activities on the environment and the effect this change has had on decision makers and governments. For, in this respect, in Québec as in every industrialized country, people have shown a growing and effective awareness of the importance of environmental questions. Space is now perceived as a rare resource, threatened, limited and perishable. People everywhere agree that efforts must be made to correct past errors and preserve the future. The energy sector is confronted with this change, precisely because its development entails, to a greater or lesser extent, disruptions in the environment.

Governments as well as enterprises have taken note of this phenomenon. In effect, over the past decade, increased resources have been allocated for the protection of the environment. In Québec, the leading corporation in the energy sector, Hydro-Québec, has considerably increased the share of its budget devoted to the management of environmental questions. The many levels of government, in their respective jurisdictions, have applied regulations, standards or monitoring procedures all aimed at controlling and limiting the effects of energy-related activities on the environment. An equilibrium is now being established: taking into account environmental questions has become an inseparable part of any reflection concerning energy development. An energy policy must tackle the environmental question head-on and explicitly.

An Unstable International Energy Context, Still Dominated by Oil and Increasingly Competitive

In all areas of economic activity, energy is probably one of the sectors where national markets are most tied to the international situation. Québec is no exception: on the contrary, over the past fifteen years, the Québec energy situation has been particularly affected and transformed by upheavals on the world market. It is therefore essential to grasp as clearly as possible the present and future trends of the international energy context.

Oil, the Predominant Energy Form

A first fact stands out: despite the energy crisis and the phenomena of adjustment that ensued, oil remains the predominant form of energy on the world energy market. Furthermore, there is no indication that this situation will change in the short or medium term. For example, though it is true that since 1971 the share of oil in meeting world energy requirements has declined, this reduction has been relatively restrained. Fifteen years ago, oil represented 56% of the energy demand of the member countries of the International Energy Agency. In 1985, this share was still 52% and the IEA predicted that oil would still represent 48% of the energy requirements of its members in the year 2000.

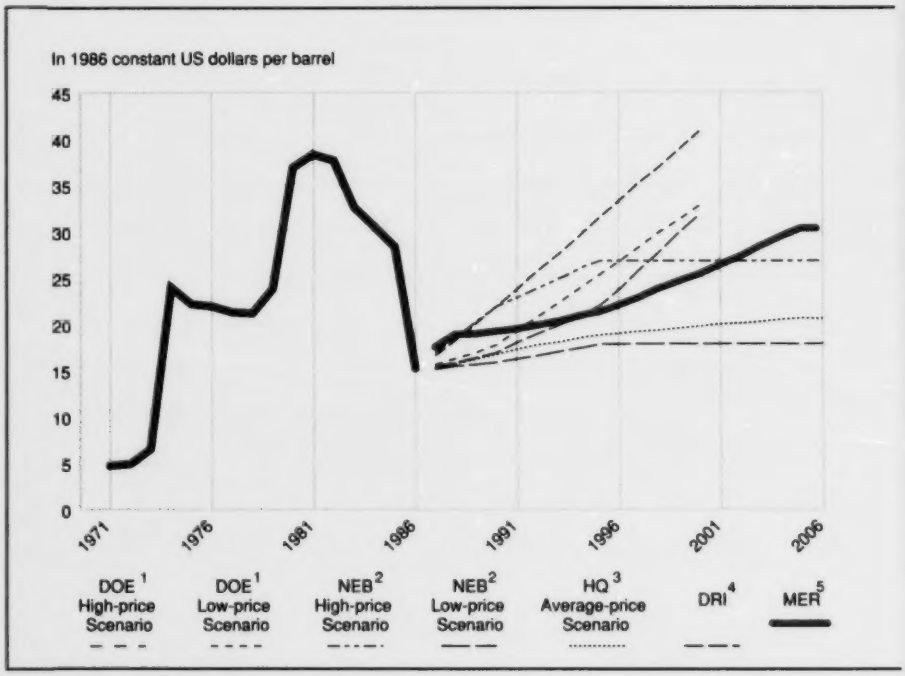
The very influence of oil markets on the global energy scene has not really been affected by this drop. To be convinced of this, one need but recall the impact of the fall of oil prices, in 1986, on the development of all energy sources. This phenomenon should not come as a surprise. Oil is still, and by far, the most widely used conventional energy source in the world. The physical characteristics of oil-generated energy allow it to outperform all other energy sources now in use because it is easy to use and adaptable. Production costs of the most economical oil fields give producers an important margin of profit, compared to competing energies. Finally, there are some specific markets — mainly in the transportation sector — that remain dominated by oil and where real change in this situation is not expected in the medium term.

Changes in the Price of Crude Oil: Markers for the Future

As in past years, changes in the price of crude oil on the international market will thus constitute an essential element of the energy situation. Should we attempt a forecast on this score? The performance of estimates of oil prices in past years suggests caution. We may, however, begin with a few obvious facts. Structurally, oil markets changed radically in the early 1970s. Until then, the international oil sector had been very steady, as reflected in its price stability. This stability was due to the exclusive control oil companies wielded over the entire market, from production to consumption. Since 1970, decision making centers have split and multiplied; competing, inconsistent strategies have been applied, resulting in obvious instability, especially regarding prices. There is every indication that this instability will endure and must be managed as such by the decision makers.

If the factors determining prices on the international market are analyzed more precisely, a few assumptions can be made. In a highly unstable environment, certain guidelines

Graph 19
Prices of International Crude Oil
1971 - 1986 - 2006



1. Source: United States Department of Energy, March 1987.
2. Source: National Energy Board, October 1986.
3. Source: Hydro-Québec, March 1986.
4. Source: Data Research Institute, 1986 Edition.
5. Source: Ministère de l'Énergie et des Ressources du Québec, January 1988.

Source: Direction générale de l'analyse économique et financière of the ministère de l'Énergie et des Ressources.

exist amid oil price variations, markers that guide in the short or medium term and prevents oil prices from rising beyond certain limits. On the downside, these markers correspond to the financial requirements of OPEC members, the prices of competing energy forms, crude oil production costs, as well as the policies and preferences of international companies and major importing countries. Inversely, the marginal production costs of non-OPEC producers and the price of competing energy forms both constitute limits to an increase in oil prices. Based on these guidelines, it can be estimated that, on the long run, oil prices should not fall below $15 US per barrel (1986 dollars), or top approximately $30 US per barrel. On a short-term basis, the maximum threshold of the price of crude could stand at about $20 US per barrel.

A more exact scenario of crude oil price changes can be drawn from certain specific assumptions. By presupposing sustained economic growth, an increase in the supply of non-OPEC oil until 1995, the subsequent stability of that supply and, until 2006, the steady output capacity of OPEC countries, the scenario selected implies that the price of crude would rise to slightly more than $20 US per barrel (1986 dollars) by 1991, stabilize at $22 US by 1996 and at $31 US by 2006. Such a scenario obviously does not exclude sharp drops or brutal price increases in the short term. This scenario means in effect that we must wait nearly twenty years to return, in constant dollars, to the level of crude oil prices recorded in 1985. This is an important conclusion for the development of all energy sources.

The Internationalization of Industrial Economies

If we now look at all economic activities, it can be seen that a fundamental phenomenon has been around for many years, that of the internationalization of economies. In every industrialized country, the elimination of custom barriers and the fight against protectionism have proven to be the most effective means of ensuring lasting and sustained growth. The energy sector was already quite open to international competition. It has therefore been affected only in a limited way by this general movement. More than ever before, however, the comparative advantages in the area of energy are becoming especially important and appear as privileged means to improve the ability of companies to compete internationally.

With the signing of the free trade agreement between Canada and the United States, the internationalization of the economy has taken on an added dimension in North America. In the energy sector, this accord includes many advantages for Québec: while maintaining certain potential controls in view of protecting the security of fossil fuel supplies, in the short term the Free Trade deal will lead to the elimination of custom duties now affecting petroleum product sales on American markets. In the electricity sector, the Canadian-American agreement wards off protectionist trends. It will simplify export control methods, which should eventually lead to their true deregulation. More generally, this accord constitutes for all economic agents the obligation to reduce costs, improve productivity and increase the quality and originality of production. Access to various forms of energy at competitive prices will help companies face the new North American trade context.

OPPORTUNITIES AND OBJECTIVES

- **Challenging Opportunities**
- **The Energy Policy Objectives**

Challenging Opportunities

Our assets are many. With respect to energy supply, Québec has access to abundant resources. On its territory, large-scale projects have led to the development of considerable hydroelectric resources. Within Canada, an important system of oil and gas pipelines links Québec distribution centers to western fields. Québec also has open access to the international oil market. As for energy demand, the market is more competitive, more efficient than it ever was. Over the past few years, consumers have demonstrated their ability to adapt to supply conditions.

These assets have earned the energy sector an essential position in Québec's economic system. Out of hydroelectric developments, Québec has built a sector of activities and developed areas of expertise whose performances are measured on an international scale. A major source of investments, Québec's energy sector is also a powerful industrialization factor. Québec's energy assets have been very attractive to energy-intensive industries.

The full exploitation of these advantages constitutes a particularly exciting challenge for the next decade. The yet untapped hydroelectric potential remains impressive. The renewable feature of hydroelectric energy confers an exceptional value to this potential. It also means that any delay in its development represents an irretrievable shortfall. The existence of a dynamic domestic market, the proximity of regions where future requirements are high, both guarantee a solid base for the future developments of this potential. Energy costs and price stability can represent a determining factor in the ability of Québec enterprises to compete. The impact of the growth of the energy sector on the industrial structure and regional economic development can still be reinforced and maximized.

Appropriate action also offers means to remove many of the uncertainties of the future. The international energy market is unstable and prone to periodic imbalances. Security of supplies thus remains a major concern. Québec's access to Canadian fossil fuel resources at competitive prices is a means of both strengthening this security and ensuring competitive supplies for many strategic sectors of economic activity. The development of the Montréal petrochemical industry is tied to the conditions of supplies of oil and natural gas liquids. After undergoing a difficult period of adjustment, the refining industry must be consolidated and strengthened.

Through its energy policy, the government intends to fully exploit our assets and accept the economic and energy challenges of the future.

Energy Policy Objectives

Over the next few years, government action in the energy sector will be carried out with certain priority objectives in sight. These objectives will guide the government's overall energy policy. In some situations, delicate and difficult choices will of necessity be made between them. However, the government considers they can be pursued simultaneously by means of a strategy relying on the energy sector to meet the challenges of the 1990s.

1 The government **will utilize the energy sector to spur economic development and support regional development**. It will make full use of the energy assets available to

Québec to support and reinforce growth. Energy will therefore serve to increase investments and employment, diversify the industrial structure, improve the balance of trade and contribute to the implementation of the government plan of action with respect to regional development.

- The government is well aware of the primary role played by energy in industrial development. **One of the goals of the government is to maximize the industrial spinoffs from energy activities** - construction spinoffs from the building and development of energy projects, and production spinoffs from the use of energy.

Among its efforts to encourage industrial growth, the government will pay special attention to technology transfers and research activities.

2 The government **will develop and maximize the use of our hydroelectric resources**. This objective is based on the very nature of the hydroelectric resource, on the numerous possibilities for its development and utilization, and on the major related economic spinoffs.

3 The action of the government will aim **to ensure and strengthen the security of energy supplies**. The development of the abundant hydroelectric resources and the improvement of efficiency in the use of energy will directly contribute to such a reinforcement. Québec's access to all Canadian and foreign sources of fossil fuel supplies at competitive prices is an essential element of this security.

4 One of the government's specific objectives is **to guarantee Québec's access to Canadian resources at competitive prices**. Such access is the very condition of the development of numerous sectors of activity. This is especially true of petrochemicals.

5 The government will foster **competition in the energy industry for the benefit of Québec consumers**. Opening markets to the main forms of energy to invite greater competition is an objective of social fairness and economic development alike.

Québec consumers will be in a position to make choices that are more enlightened and at better prices. Sound flexibility with respect to the relative price of the various forms of energy will improve the competitiveness of enterprises, as well as industrial development. It will incite all parties to be more efficient.

6 In order to ensure harmonious economic and energy development, **the government will include greater energy efficiency and diversity** among its main objectives. The goal of greater energy efficiency and diversity is both a better utilization of existing energy sources and the promotion of alternative energy forms now being developed technologically. Greater energy efficiency and diversity are thus important means of supporting economic and industrial development, improving security of supplies and fostering competition between the various energy sources.

7 Finally, the government's entire energy policy will be applied with **the constant concern of protecting the environment and the quality of life**. It is becoming increasingly clear that economic development will not endure if it leaves in its wake the continued degradation of the environment. However, protecting and improving the environment require considerable economic and financial resources, sustained

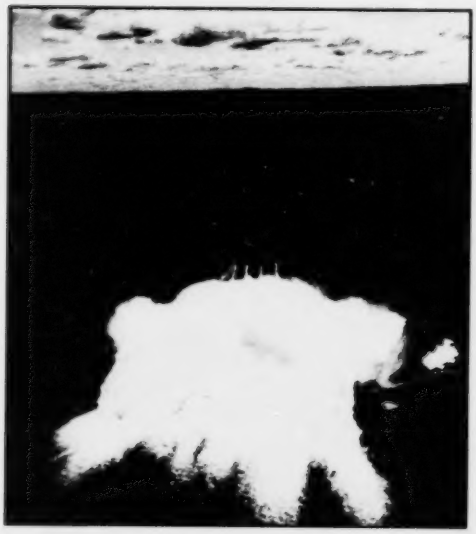
technological support as well as solid and lasting economic growth. For the government, economic development, the growth of the energy sector and the protection of the environment are not, by any means, contradictory objectives. They must go hand in hand and be carried on simultaneously.

ELECTRICITY

- **Opportunities and Objectives**
- **The Past Two Years: an Assessment**
- **Means of Action**

Opportunities and Objectives

In recent years, electricity has contributed significantly to strengthen Québec's security of energy supplies, thus reducing its dependency on foreign markets. The goal of the expansion of the electricity market over the next few years is twofold: to improve the energy balance sheet and foster economic development.



Spillway of LG-3 hydroelectric complex.

Indeed, Québec's hydroelectric potential is an important collective asset and a powerful lever for economic development, which greatly contribute to the quality of life of Quebecers. It is estimated that the untapped potential of the large rivers stands at 30,000 MW. Of this potential, the development of some 18,000 MW would be more economical than any other way of producing electricity. To large rivers must be added the resources corresponding to small development projects. The potential of small rivers is estimated at 10,000 MW; it would be technically possible to develop half of them.

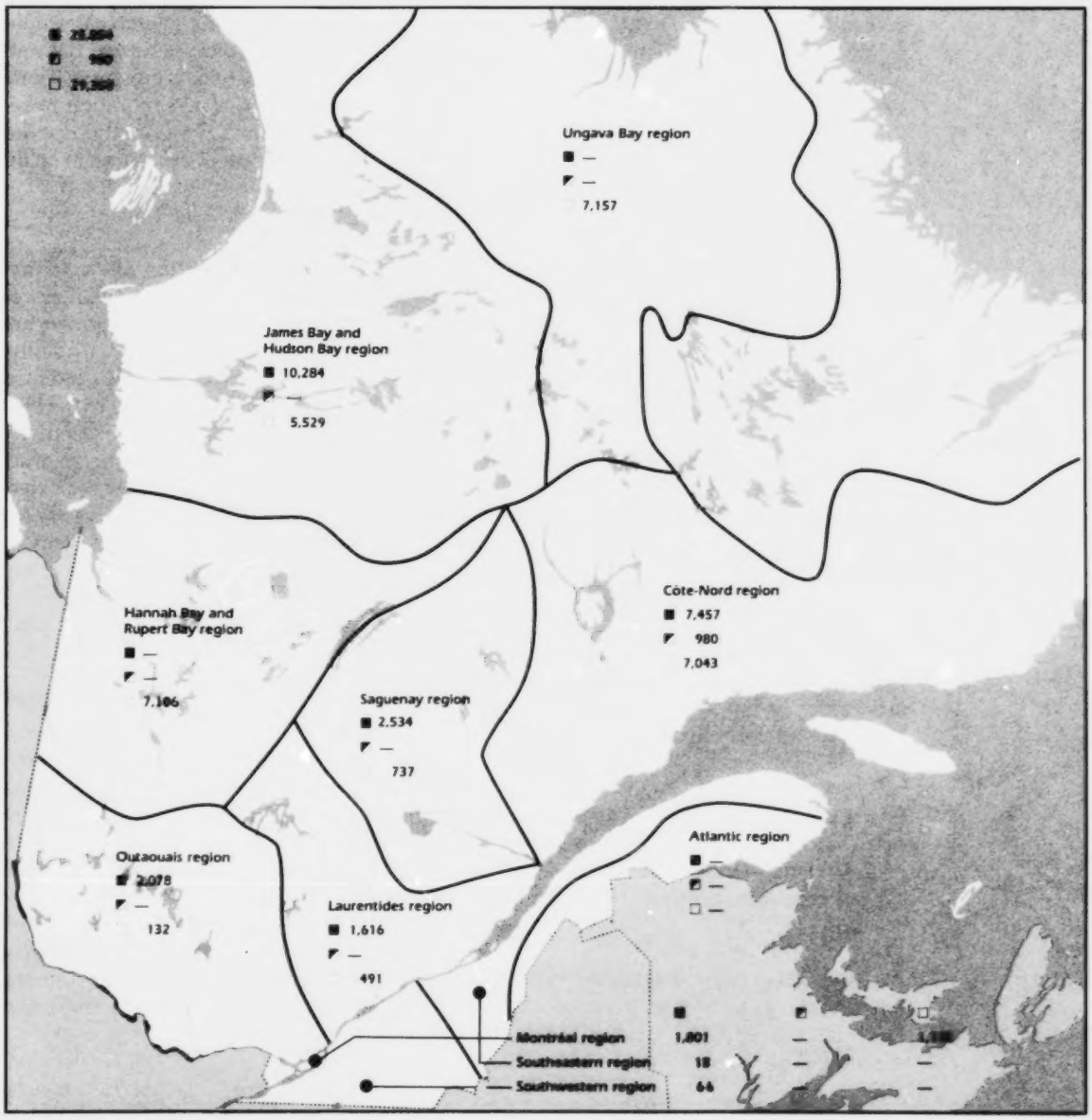
The hydroelectric potential that still remains untapped is impressive. The renewable characteristic of hydroelectric energy confers exceptional value to this potential. It also means that any delay to develop it represents an irretrievable shortfall. In the energy sector, the highest goal for Québec is to get the most out of economically viable hydroelectric resources, while respecting the environmental equilibrium.

At the present time, the development of hydroelectric resources certainly represents for Québec one of the most stimulating and promising opportunities of economic activity and expansion. Thus, by 1997, Hydro-Québec plans to invest nearly 30 billion dollars to build production and transmission facilities. For its part, the government wishes to further strengthen investments in the development of hydroelectric resources, in particular through export sales higher than actually contemplated in Hydro-Québec's scenario.

Québec's wealth of hydroelectric resources is thus our primary energy asset. Of all the conventional energy forms that make up the energy balance sheet, hydroelectricity is the only one where Québec controls all stages of production, transmission and distribution; it is the only one where Québec sets the rates and determines the conditions of supply.

This form of energy offers unique features: the hydroelectric resource is renewable; its production costs are extremely low once the initial investment is made; the basic technology employed to produce it has been known for some time; finally, although the development of hydroelectric facilities has an undeniable impact on the environment, the use of electricity does pollute less than other forms of energy. Over the next few years, the government firmly intends to give priority to this invaluable asset.

Map 1
Québec's hydroelectric resources by region
as of January 1, 1987



■ Developed resources
◤ Resources under development
□ Theoretically potential resources, including only power of 100 MW or more

Source: **Energie in Québec,** 1987 Edition.

• ***Contributing to industrial development***. For the government, the modernization of this highly sensitive sector of the economy, the establishment of energy-intensive industries that generate jobs, the maintaining of electricity rates at a relatively low level for all enterprises are essential means of developing Québec's industry.

The government will help promote high efficiency electric technologies. It will use the electricity rates that Québec can offer to improve the ability of Québec companies to compete on national and international markets. These rates will enable Québec to attract firms for which energy constitutes an important production factor.

• ***Maximizing economic spinoffs***. The development of the hydroelectric potential has a direct impact on a great many economic activities. The content of Québec's investments in the production, transmission and distribution of electricity is already quite high. Yet, it must be increased. The regional spinoffs of these investments can still be expanded. Québec's economy must take full advantage of the specialized jobs that are linked to these development activities.

In the next few years, the Québec government will thus see that the economic spinoffs of major hydroelectric projects have the greatest possible impact on economic activity.

• ***Encouraging the production and efficient use of electricity***. The production of electricity as well as its consumption must be ensured at minimum cost and in a rational way.

As regards costs, Hydro-Québec's size enables it to benefit from important scale economies. Optimal planning for all of Hydro-Québec's facilities requires, however, a very careful evaluation of electricity needs. That is why the government will encourage Hydo-Québec to manage in an optimal way already developed hydroelectric resources, rationally develop the yet untapped potential, and apply demand management measures. These measures will allow the corporation to reduce the average cost of electricity supplies by increasing the rate of utilization of facilities.

As for rational consumption of electricity, the government estimates that, overall, prices reflect supply costs and that consumers are thus encouraged to use electricity efficiently. Moreover, Hydro-Québec has also taken on the task of informing consumers of the best ways of using electricity. Where electricity competes with other forms of energy, market forces will foster a more efficient use of electricity while preserving the interests of consumers. In addition, demand management measures will incite consumers to a more rational use of electricity since they will encourage the use of electricity outside peak periods.

The existence of captive markets for electricity and the specific character of the distribution of this energy form require that consumer interests be protected and guaranteed. The government will continue to directly approve electricity rates. The main criteria that will be applied in setting rates will be Hydro-Québec's financial situation, production costs, the competitive position of electricity, the fair treatment of customers, and the ability of Québec consumers to pay.

• ***Promoting electricity exports***. Neighboring networks will be required to meet growing electricity needs in the next few years. To meet them, they will be facing the increasingly high costs of building and operating thermal power plants, be they con-

ventional or nuclear. These factors, combined with the relatively low production costs of Québec electricity, suggest the existence of a high sales potential on these markets by the year 2000. The government is convinced that this situation could justify a substantial rise in exports over the same period.

Thanks to an increase in exports, Québec will accelerate the development of its hydro-electric potential by starting ahead of schedule the construction of base-load generating stations that will subsequently serve to meet the requirements of Quebecers. The construction phase will require large investments and involve the creation of thousands of jobs during the next decade. Moreover, electricity exports will make it possible over the years to lower electricity rates for Québec consumers. They will improve Québec's energy balance sheet and balance of trade.

- ***Improving the quality of customer service.*** In recent years, the quality and reliability of customer service has been a concern of Hydro-Québec and the government. Important efforts have been made on this score and substantial improvements have been observed. Still, consumers have the right to a reliable power transmission and distribution system and to efficient customer service. The government considers this aspect of Hydro-Québec's activities a priority and intends to take appropriate means to ensure reliable and quality service to all the public corporation's customers.

- ***Facilitating consumer participation.*** Hydro-Québec plays an essential role in the quality of life of Quebecers. As an energy producer, Hydro-Québec operates where consumers often constitute a captive market and have no other choice than to have recourse to the services of the government corporation. As a major actor on the economic scene, Hydro-Québec plays a significant role in economic, social and environmental matters in Québec. In the next few years, and thanks to adequate mechanisms, the government will help consumers increase their say in Hydro-Québec's orientations.

- ***Ensuring the sound financial health of Hydro-Québec.*** Needless to say, the objectives set forth previously will be pursued bearing in mind the profitability of Hydro-Québec's operations.

The Past Two Years

An Assessment Increasing Exports

In the past two years, the electricity sector has been highlighted by the promotion and development of exports, particularly on the American market. Until 1985, Hydro-Québec's export strategy consisted in selling its surpluses on neighboring markets. In 1986, for the first time, the public corporation considered the possibility of carrying out export sales through changes in its equipment plan, by launching hydro-electric projects ahead of schedule. A new stage was reached in 1987 when Hydro-Québec designed a target scenario that included exporting 3,500 MW of guaranteed energy and power, and that was integrated in the public corporation's planning.

Over the past two years, Hydro-Québec concluded a number of short-term agreements with, among others, the Niagara Mohawk Power Company, the New England Power Pool, and the New Brunswick Electric Power Commission. Revenues from electricity sales resulting from these agreements are estimated at nearly half a billion dollars (in current dollars).

At the same time, the sales strategy for guaranteed power and energy resulted, in February 1987, in the signing of a letter of intent with the Central Maine Power Company for the delivery of 400 MW to 900 MW between 1992 and 2020. A second agreement in November 1987 led to the signing of a contract with Vermont Joint Owners for the sale of a 200 MW to 500 MW block for twenty years beginning in 1995. Moreover, Hydro-Québec and the New York Power Authority signed a memorandum of understanding under which the government corporation will deliver two blocks of 500 MW each between 1995 and 2016.

The signing of the Agreement on Energy Cooperation between Québec and the State of New York. From left to right: Robert Bourassa, Prime Minister of Québec; John Ciaccia, Minister of Energy and Resources of Québec; William D. Cotter, Commissioner of the New York State Energy Office; Mario Cuomo, Governor of New York.

Photo: Communications - Québec

These agreements together with the contract amount to electricity sales of 2,400 MW, or nearly 70% of the objective contemplated by Hydro-Québec. They represent revenues evaluated at 40 billion current dollars for a twenty-nine-year period.

Thus, electricity exports will entail the beginning of construction ahead of schedule of all the basic power plants of the equipment program. As concerns Phase II of the La Grande complex, namely, the LG-1, Brisay and Laforge 1 power plants, operations will begin, on the average, five years ahead of schedule.

Deregulating Exports

Electricity exports to the United States are subject to certain rules decreed by the federal government and whose application led to difficulties in the past. In 1987, Hydro-Québec thus faced many problems before obtaining from the NEB an export licence for 70 TWh of firm energy with the New England Power Pool. This licence was finally granted in February 1988.

In 1986, the Québec government and Hydro-Québec intervened many times for greater deregulation of electricity exports. In effect, electricity is both a manufactured good and renewable energy, and should not be subject to export restrictions. Moreover, the mechanisms used by the NEB to encourage sales to other provinces distort the process of negotiations between public utilities and are harmful to the objective sought. In June 1987, the NEB presented the federal government with a report proposing various options concerning amendments to existing electricity export regulations. To this day, the federal government has not taken a position as to the changes to be applied to this regulation. Given that Québec is still willing to supply at

similar conditions electricity to its Canadian neighbors, the Québec government is pressing for the revision of the federal regulation to permit the exportation of this resource without hindrance.

Moreover, the Québec government has supported the Canada-U.S. free trade agreement under which the markets of the two countries, particularly in the energy sector, will be more open. As regards electricity, this agreement will help alleviate uncertainties relative to protectionist actions that threaten exports.

Domestic markets: demand management, sales promotion in the industrial sector, and rates

With respect to domestic markets, government action as well as that of Hydro-Québec sought to increase the place of electricity in Québec's energy balance sheet and to best meet all the electricity needs of Quebecers. As regards demand management, in recent years the government has authorized special rates under Hydro-Québec's commercial programs. The dual-energy rate intended for residential customers taking part in the Dual Energy Plus program is the first of these. The objective is to consolidate and increase the number of current residential dual-energy users to 150,000 units. Dual-energy rates have been introduced under the commercial, institutional and industrial dual-energy programs. Finally, changes have been brought to rates affecting interruptible power in order to allow Hydro-Québec to gradually increase the interruptible power capacity from 500 MW to 2,000 MW by 1996. On the whole, these programs should reduce demand at peak periods by 5,000 MW, by the year 2006. This will represent important savings in terms of the construction of peak-load facilities.

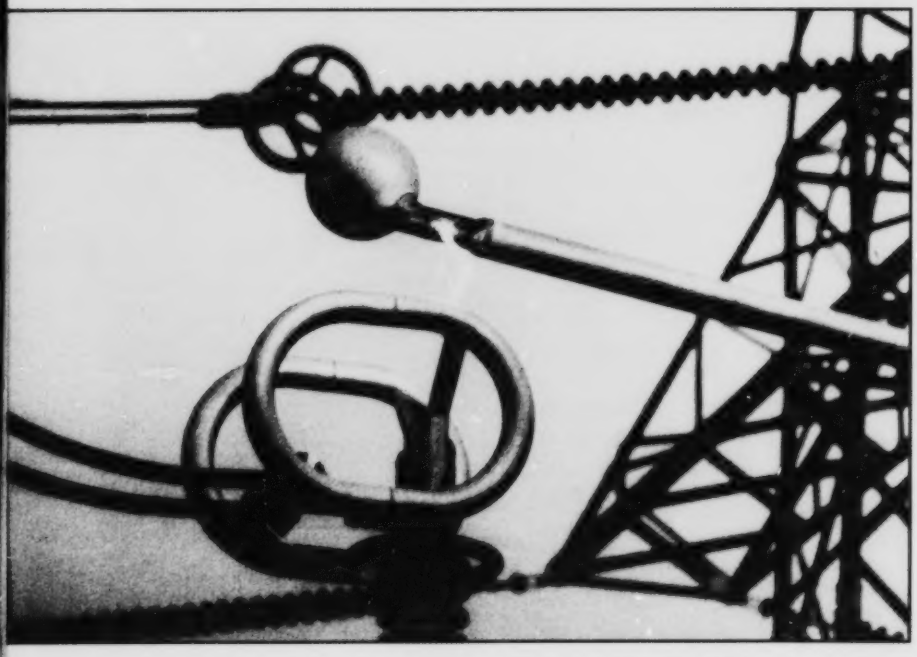
Regarding the development of the industrial sector, in addition to dual-energy and interruptible power programs, Hydro-Québec, with government support, has introduced two other programs for sales promotion. The financial assistance programs for the implementation of electrotechnologies encourages the introduction of highly efficient electric technologies in industrial processes, and thus improves the ability of Québec industries to compete. In early 1988, 257 customers benefited from this program, which represented demand for 287 MW, or 96% of the goal that had been set. Hydro-Québec's risk- and profit-sharing program is aimed at keeping or attracting major investments in Québec. The government has authorized the signing of many contracts with energy-intensive industries in connection with this program — the main ones being Norsk-Hydro (construction of a magnesium plant at Bécancour), Cascades (establishment of a pulp plant at Port-Cartier) and QIT-Fer et Titane (expansion and modernization of a titanium oxide and pig iron plant).

As concerns electricity rates, increases approved in 1986, 1987 and 1988 were close to the inflation rate. Québec's electricity rates were thus kept among the lowest in North America while, at the same time, Hydro-Québec's financial situation had improved.

In 1987, the government agreed upon the principle of the eventual reduction of cross-subsidization existing between Hydro-Québec's main rate categories. The government also decided that the terms and conditions of the application of this principle should be discussed with Hydro-Québec.

Resumption of Major Projects

Hydro-Québec's fine sales performance, on both internal and export markets, has begun to have an impact on hydroelectric development projects. After a complete halt in the construction of major projects, which lasted nearly five years, development of the hydroelectric potential resumed. Two major projects were undertaken in 1987, namely that of adding to the capacity of the La Grande 2 generating station at James Bay (1,900 MW), and that of the Radisson-Nicolet-Des Cantons 450 kV direct current line (1,100 km). Investments tied to these projects amount to more than 3 billion dollars.



Disconnecting switch in a Hydro-Québec transforming station.

photo: François Boulay

Furthermore, on March 8, 1988, the Prime Minister of Québec officially announced the beginning of work on phase 2 of the La Grande complex, namely the construction of the La Grande 1 (1,296 MW), Brisay (385 MW) and La Forge 1 (783 MW) generating stations, as well as the construction of the twelfth line at 735 kV. These projects will require investments of nearly 8 billion current dollars over a seven-year period, and will create direct and indirect jobs estimated at 40,000 person-years.

Means of Action

Contributing to Industrial Development

Hydroelectric development strengthens Québec industry. This objective can be attained by encouraging investments by electricity-intensive enterprises, increasing the competitiveness of Québec industry, fostering new industrial activities, and guaranteeing rate stability over long periods.

Fostering the Establishment of New Enterprises and the Expansion of Existing Ones

The price of electricity, its availability and especially the assurance of reliable long-term supplies are very important location factors for energy-intensive firms that use electricity. Besides, for these enterprises, Québec represents a gateway to the American market.

At the present time, a number of investment projects are under consideration. More specifically, Québec is in a position to benefit from the worldwide redeployment of aluminum smelters, while the Montréal region offers many advantages for the organic electrochemistry industry, which uses electricity and natural gas. The government will also

establish various complementary measures to encourage investments by energy-intensive companies using electricity. Among these means, the government plans to:

- intensify industrial canvassing through concerted action to attract potential foreign investors, and by showing the advantages of establishing facilities in Québec;

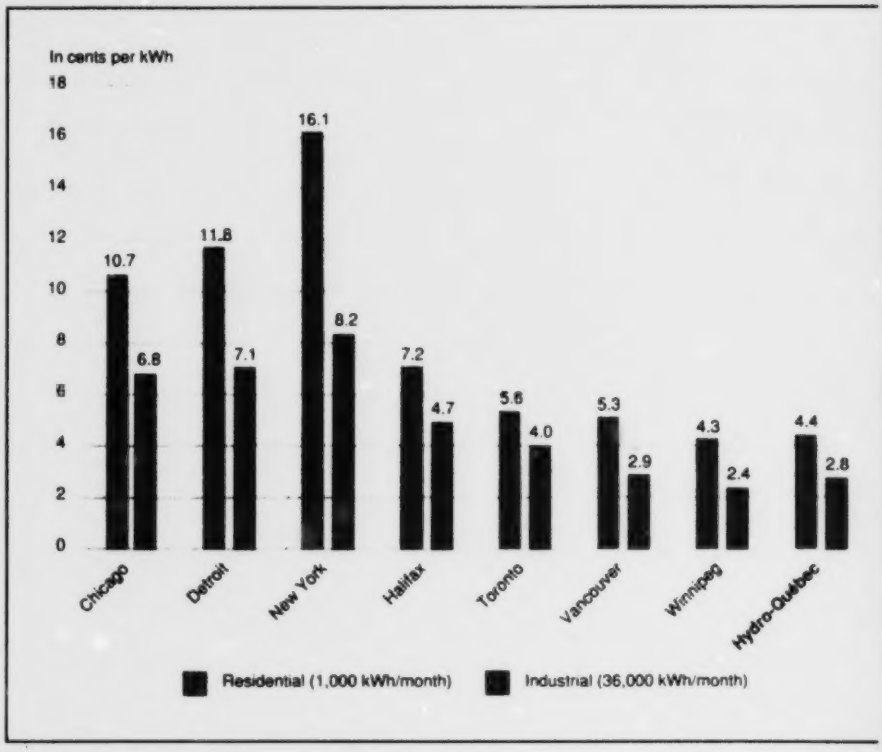
- obtain the support of financial institutions that will participate in the financing of the James Bay project in order to attract new industrial enterprises to Québec;

- retain the risk and profit sharing formula proposed by Hydro-Québec, and seek to give it a greater impact on regional development;

- ensure supplies and the stability of electricity rates over long periods.

Also, to foster industrial development, the government will request that Hydro-Québec keep a certain reserve of power and energy. In the normal planning of facilities, a margin of operation is included to handle certain unforeseeable circumstances, such as precipitation levels and sudden changes in demand for electricity. In addition to these factors, the government believes it is important that Hydro-Québec maintain an adequate electricity reserve so that Québec's economy might benefit from significant development opportunities.

Graph 20
Comparison of Electricity Prices in Québec and Selected North American Cities in 1987 (not including sales tax)



Source: Direction de l'électricité, ministère de l'Énergie et des Ressources du Québec, May 1988.

Increase the Competitiveness of Existing Québec Companies

The use of efficient electric technologies and the relatively low price of electricity in Québec foster the competitiveness of Québec firms. The introduction of new technologies is often accompanied by an important upgrading of production equipment as well as the improvement of the quality of the workplace and the environment. For the government, it is essential that Hydro-Québec set up a new, more aggressive program to introduce electrotechnologies.

The relatively low price of electricity is one of the main advantages of the Québec economy. The government intends to preserve it.

Major Electrotechnologies

Electrotechnologies are equipment or systems that use electricity for manufacturing, processing or refining materials or products. Among the major electrotechnologies, the following should be mentioned:

Electric Arcs
An electric current passing between two electrodes and capable of melting materials. Applications: smelting, ferrous-alloys, etc;

Induction
Materials conducting electricity heat up rapidly when placed in the magnetic field of an inductor under tension. Applications: metal processing, etc;

Microwaves
A nonconducting material is heated when submitted to a very high frequency electric field. Applications: heating and drying products, etc;

Plasmas
Gas (air, argon, nitrogen, etc.) in contact with an electric arc in a plasma torch reaches very high temperatures. Applications: smelting and metal refining, etc;

Heat Pumps
Heat or cold can be obtained by compressing or expanding gas. Heat pumps produce more heat than they consume electricity. Applications: drying materials, recovering energy, etc.

Infra-red Rays
Waves emitted by lamps or elements transfer electric energy from a source to an object. Applications: drying, cooking food, etc.

Mechanical Recompression of Vapor
Vapors produced through the evaporation of a liquid are recompressed and used under higher pressure and temperature. Applications: concentration and distillation of liquids, etc.

Electrical Resistance
Passage of electric current in a conductor produces heat capable of heating materials. Applications: water heater, oven, etc.

Action aimed at more efficient production and use of electricity will have a favorable effect on prices. Moreover, profits from exports should eventually influence the electricity rates of Québec companies.

Developing Small Hydroelectric Sites

The potential of small rivers it is technically possible to develop is about 5,000 MW. However, for now, independent producers are basically interested in developing idle sites with a potential of 300 MW. Based on current or future projects, investments in the next few years will total 150 million dollars. This new industrial activity will have vari-

ous economic spinoffs: the manufacturing of electromechanic facilities with a Québec content of close to 40%; the participation of engineering consulting firms for technical and economic, as well as environmental studies; the training of qualified workers; and the creation of jobs in the regions.

For its part, in 1987 Hydro-Québec approved the terms and conditions for the purchase of electricity produced by hydroelectric power plants with an output capacity equal to or less than 25 MW, or by any other plant producing electricity from resources other than water.

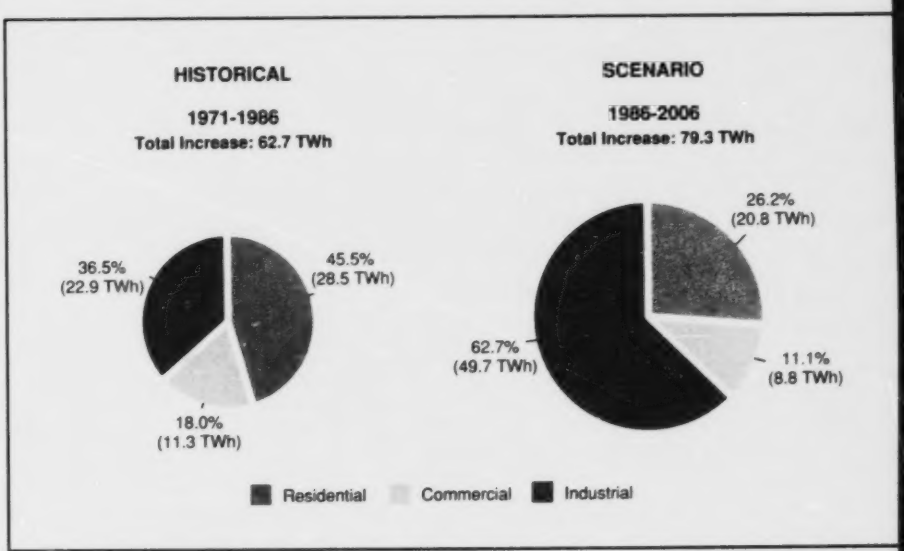
For improving and replacing equipment, as well as for managing demand and developing new electrotechnologies, Hydro-Québec relies primarily on its research teams and laboratories. However, research and development activities must be oriented toward the industrial sector. Hydro-Québec has entered into partnerships with the private sector to pool its technological resources with those of private companies better able to produce and market products in demand on the world market. The Québec government approves of these initiatives and plans to support Québec firms that have the opportunity to do business on international markets.

Maximizing Economic Spinoffs

The development of hydroelectric resources is an activity that is firmly integrated in the Québec economy. The government intends to authorize the building of new power plants. Means will be taken for these projects to boost the economy as much as possible.

The Québec content of the investments required to produce and deliver electricity to Hydro-Québec's customers is estimated at 80%. Québec engineering consulting firms, which already possess acknowledged expertise in project management, are in a position to fully benefit from the launching of major construction projects and pursue their expansion on international markets. A large part of the facilities required to produce and transport electricity can be obtained from manufacturers and suppliers established in Québec. Québec companies should therefore benefit directly from purchases made by Hydro-Québec. The public corporation will announce its needs soon enough for Québec companies to get ready, reorganize if need be, and bid competitively.

Graph 21
Growth of Regular Electricity Sales in Québec
1971 - 2006



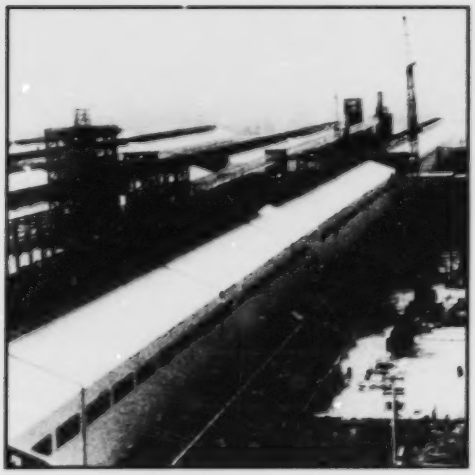
Source: Direction de l'électricité, ministère de l'Énergie et des Ressources du Québec, May 1988.

Encouraging the production and efficient use of electricity

The government plans to encourage the production and efficient use of electricity through the following actions:

Consolidating and intensifying demand management measures

Demand management measures are advantageous to all of Hydro-Québec's customers as they reduce the average cost of supplies, which reduction in turn limits rate increases. Thus, interruptible power and dual-energy sales programs reduce the need for power during peak periods and increase the rate of utilization of the equipment. The application of these programs reduces the average cost of electricity supplies. The government will give priority to developing the market for electricity outside peak periods.



Hydroelectric development strengthens Québec's industries. Construction of the Aluminerie de Bécancour plant.

Examining New Rate Options for Electricity Consumers

The cost of electricity supplies varies according to the hours and seasons these supplies are consumed. Thus, production costs during peak periods are clearly higher than those outside peak periods.

At the present time, the dual-energy and interruptible power rates reflect more specifically this situation. The government will also study the possibility of integrating daily and seasonal rates in order to favor, on the one hand, the elimination of peak periods and, on the other, promote the use of electricity in off-peak periods. These options for electricity rates will help reduce cross-subsidization between rate classes. They will help reduce the consumer's electricity bill.

Optimizing the Use of Facilities

The government plans to ask Hydro-Québec to accelerate the program for optimizing hydroelectric power plants. This program is part of an overall effort to develop hydroelectric resources and, as such, has a direct bearing on economic activity.

In 1992, Hydro-Québec will be able to use interconnections with a total simultaneous capacity of 7,535 MW. While taking into account breakdowns, network constraints and maintenance, the Québec government will ensure optimal use of these interconnections.

Reducing Hydro-Québec's Operating Costs

For the past few years, Hydro-Québec has undertaken to reduce its operating costs. This effort will be exerted in its various ac-

tivities. The government intends to pay special attention to sub-contracting, the control of total wages and the rationalization of the corporation's operations.

Promoting Electricity Exports

Strategies for promoting exports are focused on means of action that the government intends to apply in collaboration with, and as a complement to, Hydro-Québec as well as Canadian and American intergovernmental agencies. The government and Hydro-Québec plan to devote additional human and financial resources to this end.

Châteauguay converting sub-station.

Diversifying Electricity Export Products to Fully Benefit from the Complementarity and Particular Needs of American Networks

The needs of neighboring networks are not limited to guaranteed power and energy. The North-South differences in the characteristics of electricity demand explain why there is a market for "diversity power". This product, which consists in selling megawatts for a limited number of months during the year, has the advantage of not requiring new peak-load facilities since electricity is delivered outside peak periods. As neighboring networks will, again in the years to come, rely on electricity produced from oil- and coal-fired generating stations, the Québec government will seek to replace part of the output of these power plants with contracts for the sale of guaranteed energy and power, of firm energy and seasonal power.

Favoring Canadian Electricity Exchanges

After Quebecers, it is other Canadians that must benefit from Québec's hydroelectricity. Thus, the Québec government intends to give priority to sales to neighboring provinces at comparable conditions. As Québec has emphasized, during the inquiry held in 1986 by the NEB on electricity export regulations, electricity exports must be deregulated.

Maximizing the Profitability of Contracts for Electricity Exports

To meet the electricity needs of neighboring networks, Hydro-Québec will put its hydroelectric power plants in operation ahead of schedule, according to their comparative advantages. In order to maximize the profitability of exports, the government will ensure that guaranteed energy and power contracts include pricing formulas reflecting their true production costs. Moreover, since contracts extend over a long period, the government will see that they include adjustment mechanisms covering the risks incurred.

Map 2
Interconnections with neighboring networks by 1992

* Simultaneous delivery capacity to Ontario and New York State is limited to 3,210 megawatts.

Source: Hydro-Québec Development Plan 1988-1990, Horizon 1997.

Systematically Evaluating the Electricity Needs of Export Markets

Export markets for Québec electricity are many, and growing rapidly. To capture these markets, it is important to know exactly the needs of each network in terms of power and energy, and to canvas each one systematically. Also, new market studies will be conducted to determine the best sales opportunities in Canada and the United States. Additional human and financial resources will be earmarked by the government and Hydro-Québec alike to develop these markets.

Reaching New Export Markets

Access to new export markets is actually limited: Hydro-Québec sells mainly to networks with which it is directly interconnected. The Québec government plans to study, together with the Canadian provinces and American states concerned, the mutually advantageous opportunities of reaching new markets.

Designing New Development and Financing Schemes

The government's will to speed up the development of resources through exports and to carry out investments at the lowest costs and best possible conditions requires that it seek new development schemes and use financial instruments different from those Hydro-Québec has employed in the past. For instance, it is entirely possible to consider the participation of a neighboring partner in the joint development of a Québec hydroelectric complex — a development in which it would have the status of a minority partner. The government and Hydro-Québec will study this type of development thoroughly, as well as seek innovative methods of financing that take into account, among other things, the constraints inherent to the growing marginal costs of future production and transmission facilities.

Improving the Quality of Customer Service

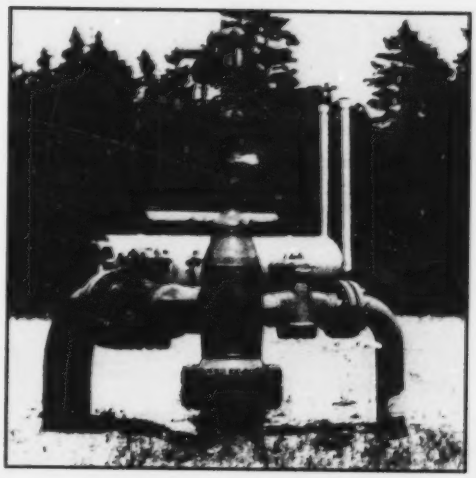
The government intends to pay special attention to the quality of service offered electricity users. In this context, the government will ask Hydro-Québec to increase its efforts by speeding up the 600 million dollars provided in its service quality enhancement program. Additional measures will have to be taken by Hydro-Québec to reduce the frequency and length of breakdowns.

Besides, electricity is actually the only form of energy distributed by a public utility for which there is no means of recourse for consumers in a dispute with the utility, barring court action. The government will also study the possibility of establishing an impartial appeal procedure for disputed cases. This could eventually lead to setting up a joint committee to handle complaints, or again to naming an ombudsman for consumer protection.

NATURAL GAS

- **Today's Challenges**
- **Government Policy Objectives**
- **A Natural Gas Policy Guaranteeing the Future**
- **A Natural Gas Policy Encouraging Competition for the Benefit of All Regions and All Consumer Categories**
- **A Natural Gas Policy Producing Industrial Development**

The introduction of natural gas in numerous Québec regions and the expansion of existing gas networks have contributed in radically changing Québec's energy picture over the past few years. Québec now enjoys a modern, well ramified gas network offering various potential clienteles a reliable, abundant and economical energy resource. Natural gas presents very few risks for the environment. Conversion to natural gas thus allows Québec to increase its potential capacity for growth while reducing the overall impact of energy on the environment.



Québec boasts a modern, well ramified gas network.

Today's Challenges

- The new context of natural gas deregulation that actually prevails in Canada represents a special challenge. The end of the agreements and controls that, until very recently, had determined the conditions and costs of natural gas supplies at the Alberta border has already allowed classes of Québec consumers to benefit from some degree of competition between Canadian gas suppliers. Thus, major industrial consumers have, in particular, been able to obtain important rebates on their natural gas purchases. As yet, however, this substantial reduction of the cost of natural gas has not been passed on to all residential, commercial and institutional customers.

- Should the deregulation of Canadian gas markets lead to the massive and uncontrolable export of Canadian gas to American markets, it could affect Québec's security of access to western gas resources. For the past two years, the Québec government has underscored this risk before the NEB at hearings on the formula for surplus determination and on projects to export gas to the United States. At these hearings, Québec declared it was in favor of easing somewhat the methods of calculating surpluses available to foreign markets. However, it also urged consistently and vigorously that its security of access to natural gas should not be reduced in the long run.

- Natural gas transportation and distribution costs alone represent more than 40% of the price paid by Québec consumers at the delivery point. The role of regulatory agencies is, therefore, absolutely essential to deal with transportation and distribution monopolies if the benefits of the deregulation of markets are to be passed on to consumers.

In Canada, it is the NEB that is chiefly responsible for controlling the major natural gas transmission companies. Québec plans to continue arguing its case before the NEB so that costs of service as well as transmission tolls and tarifs are set taking into consideration the interests of Québec consumers. It is in this spirit that the government had defended the present eastern zone, which guaranteed Québec consumers natural gas transmission costs equivalent to those paid by Ontario consumers. By adhering to the positions defended by Québec, the NEB has ensured, over the long term, the develop-

ment of natural gas in Québec, and strengthened the economic viability of existing facilities.

Distribution falls under the sole jurisdiction of the Québec government on its territory. In order to adapt regulatory structures to the deregulation context, the government has tabled a bill to amend the Act respecting the Régie de l'électricité et du gaz. The new Régie du gaz naturel will effectively protect consumers, while giving distributors the means to react quickly to competition and market forces.

- The reduction of distribution costs depends, however, on a better use of existing networks. Actually, the eastern sector of the Gas Métropolitain (GMi) network is used at only 50% of capacity. This phenomenon is explained in large part by the fact that infrastructures have just recently been constructed. A greater consolidation of existing networks would directly and favorably influence transportation and distribution costs incurred by consumers.

The Role of the New Régie du gaz naturel

The recent deregulation of natural gas prices and markets in Canada allows Québec consumers to directly negotiate the price of their gas purchases with western producers. The Québec government favors this new situation. It is essential, however, that Québec consumers have access to natural gas at prices that are at least as advantageous as those of consumers on markets adjacent to the United States.

Major industrial consumers are in the best position to benefit from increased competition between the various suppliers of natural gas. This competition could, however, be extended to other sectors of consumption. While respecting the criteria for the long-term security of supplies, the government, through the Régie du gaz naturel, will ensure that these other sectors of consumption are offered the most favorable conditions possible. In this respect, it should be noted that distributors are mandated to see to the interests of consumers.

The government has undertaken to revise the Act respecting the Régie de l'électricité et du gaz to adapt it to the new context of deregulation. The new Régie du gaz naturel will ensure that Québec consumers benefit from the deregulation of natural gas prices. The Régie will have the task of protecting consumers dealing with distribution monopolies granted to Gaz Métropolitain and Gazifère. The reform of the Act is also aimed at giving more autonomy to gas distributors to allow them to react rapidly to market forces.

Government Policy Objectives

In the natural gas sector, the Québec government's three main objectives are the following:

- All Québec consumers must benefit from the fruits of the deregulation of natural gas markets in Canada.
- Security of gas supplies and guaranteed access to Canadian resources at competitive prices must be maintained and reinforced.
- Natural gas must contribute to Québec's industrial development.

The Institut du tourisme et de l'hôtellerie du Québec uses natural gas, for more precision in cooking.

Photo: François Boulay

A Natural Gas Policy Assuring the Future

Security of Access to Canadian Resources at Competitive Prices

All of Québec's natural gaz supplies come from Western Canada. The expansion of the gas networks and gas distribution activities in Québec has been accomplished in a context where natural gas was very easily available. In addition, Québec committed itself to import Canadian natural gas because of the long-term security it offered. This was essential since the peculiarities of the natural gas trade is to make producers, transmission companies, distributors and consumers interdependent: marketing natural gas necessitates considerable funds, which can only become profitable if deliveries are guaranteed over long periods of time.

Actual reserves of natural gas in western Canada can adequately meet demand all across Canada. Large surpluses can therefore be exported. Over the last few years, pressure has been exerted to alleviate export constraints. To this end, existing NEB mechanisms have been relaxed. However, the Québec government is confident that adequate supply guarantees have been maintained. In this respect, it will remain watchful and ensure that long-term guarantees will continue to be part of the negotiations between producers and purchasers.

TransCanada PipeLine's eastern-zone rates for the transportation of natural gas define for Québec a transmission cost equivalent to that of southern Ontario. Maintaining this rate structure constitutes for Québec consumers an additional guarantee of access to this resource at competitive prices.

A System of Information on the Natural Gas Sector

It is quite obvious that it is primarily the western provincial and federal governments that control natural gas supplies. The Québec government will act especially by presenting its case before these two levels of govern-

assume, to a great extent, their own security of supplies through the contracts they will sign. It is therefore indispensable that they be provided with adequate information on the actual levels of natural gas reserves, the prices and conditions of gas sales — especially in adjacent markets — and on the deliverability of transportation and distribution networks. The Québec government therefore intends to set up, in collaboration with other governments, a system of information on the natural gas trade that will meet these new demands.

Québec Holdings in Western Canada

The government has encouraged SOQUIP to acquire interests in an important gas production corporation in western Canada, in part to meet these information needs. Thanks to the cooperation of SOQUIP, Noverco and the Caisse de dépôt et de placement du Québec, Québec interests are now in a position to influence the development of Sceptre Resources Ltd., an important western natural gas producer. As a natural gas consumer, Québec has everything to gain from having an open window on the economic and financial conditions of the production of this resource.

Other Sources of Supply

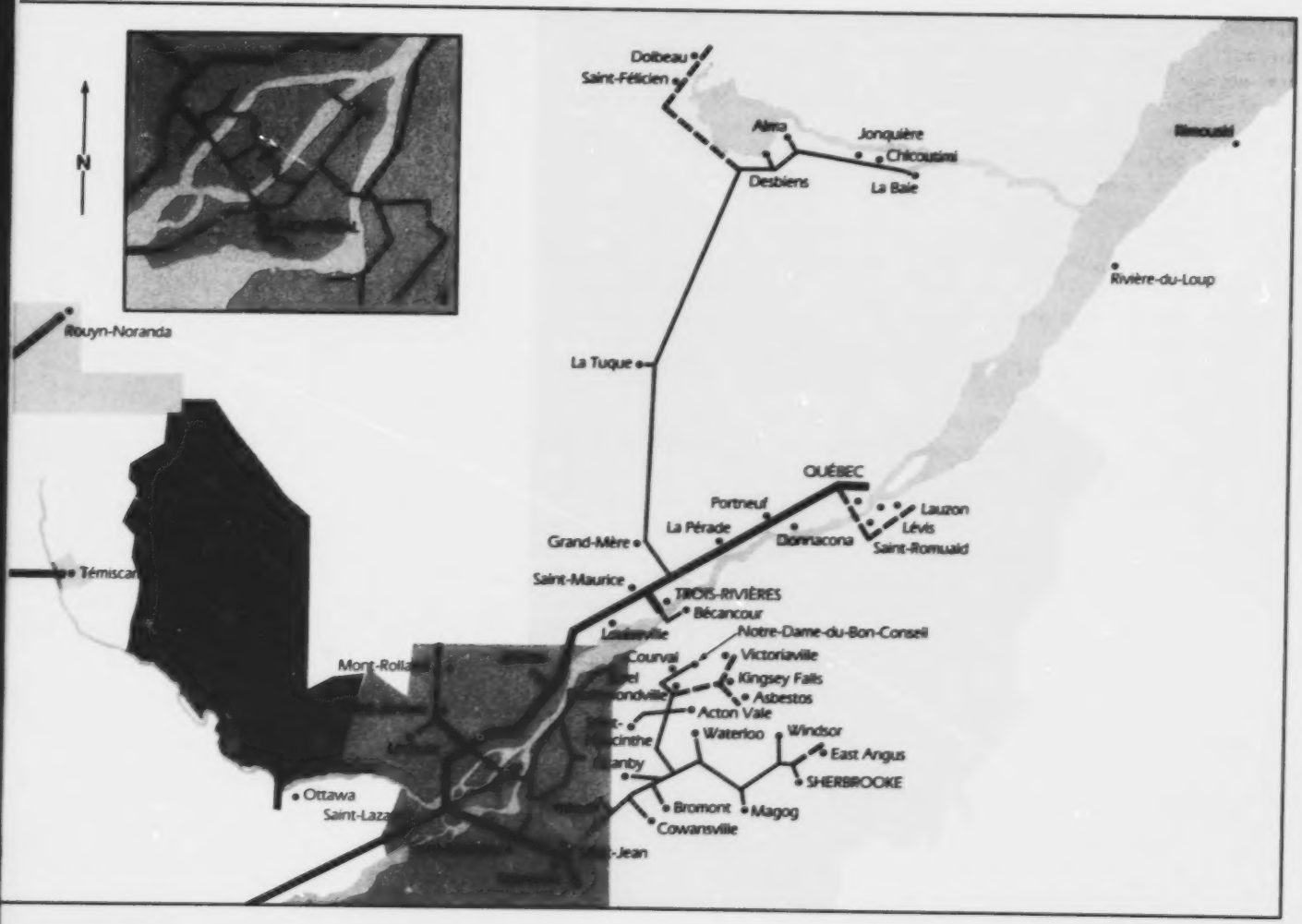
Even though, in the short run, it is probable that western Canada will still be the major and almost exclusive source of natural gas supplies, Québec intends to support any project likely to diversify its natural gas supplies. The Québec government is thus in favor of the development of east-coast natural gas resources, and is open to the possibility of establishing a liquified natural gas terminal in Québec to import liquified natural gas (LNG) by waterways.

Exploration in Québec

Although underground exploration has given few indications of the presence of economically exploitable gas deposits in Québec, nevertheless exploration work must not be halted. Greater geological knowledge of the sedimentary basins combined with the application of new exploration techniques could eventually lead to significant discoveries. These exploration activities can also help identify natural underground reservoirs that, with respect to the operation of the natural gas distribution network, have considerable strategic importance. Moreover, experiments are underway to study the possibility of storing natural gas in the municipalities of Pointe-du-Lac, Joly and Villeroy in the St. Lawrence Lowlands.

The government no longer intends to grant an exclusive mandate to SOQUIP, its public corporation, with respect to exploration activities on Québec soil. It plans to support the efforts of various private parties, especially by granting them access to all geoscientific information actually available in Québec. SOQUIP will also be able to undertake specific joint ventures with private companies involved in exploration.

Map 3
Natural Gas Transmission Networks in Québec and the Territory Covered by Natural Gas Distribution Franchises in 1987



- Réseaux de transporteurs
- Réseaux de Gaz Métropolitain
- Tracé proposé
- Région ouest
- Région est
- Région nord
- Territoire de Gazifère inc.
- Réseau de Gazifère inc.

Source: Direction générale des énergies conventionnelles du ministère de l'Énergie et des Ressources du Québec.

A Natural Gas Policy Encouraging Competition for the Benefit of All Regions and All Consumer Classes

Establishing Uniform Rates

The merger of three of the four natural gas distributors has ensured the financial stability of these firms. It has led to a greater penetration of gas in most of Québec's regions. However, natural gas rates have not completely reflected this merger since consumers that did business in the former franchise of the Gaz InterCité Québec (GICQ) company still pay distribution rates that are as much as 15% higher than those of consumers that dealt with the original GMi franchise. Customers in the former Gaz Provincial du Nord du Québec franchise in the Abitibi-Témiscamingue region also have their own rate base.

To achieve uniform natural gas distribution rates is therefore one of the elements of the government's energy policy. Providing uniform rates for natural gas is in keeping with what has existed for many decades with respect to electricity rates in Québec. It will contribute to reducing regional disparities, and help all consumers benefit from investments made by Quebecers collectively.

Consolidating Natural Gas Networks

Establishing uniform rates will foster the consolidation of distribution networks, which in turn will result in reducing distribution costs and, therefore, the price of gas in the area of the gas network where the utilization rate is lowest. The government plans to support profitable expansions of current transmission networks to cities located next to an existing network.

"Gas-to-Gas" Competition

Given the physical realities of gas distribution, the simultaneous presence of many distributors is not be to expected. However, through the Régie de l'électricité et du gaz, and subsequent to the deregulation process undertaken in Canada, the Québec government has encouraged the setting of delivery rates allowing many suppliers to seek major industrial consumers as customers, either by direct sales or by buy/sell agreements.

The government will pursue its course in this direction. It will thus encourage what has come to be called "gas-to-gas competition". It therefore intends to ask the signatories of the Agreement on Natural Gas Prices and Markets, namely, the federal government and producing provinces, in order to give producers open access — according to the spirit of the agreement — to residential, commercial and institutional markets, among which are those of Québec.

A Natural Gas Policy Creating Industrial Development

The objectives pursued by the Government in the natural gas sector lead directly to economic development:

- Eventually, investments in gas distribution networks, in particular to bring natural gas to Québec City's south shore or complete the extension of the network in the Bois-Francs and Lac-Saint-Jean regions, will entail major construction and development projects.

- The consolidation of networks will strengthen the economy of many regions. Natural gas is now available to a larger number of Québec's industrial centers; among them are the regions of Greater

Montréal, Mauricie, Greater Québec, Bois-Francs, Estrie and Saguenay—Lac-Saint-Jean. The expansion of the gas network has allowed these regions to reinforce their industrial infrastructure. These assets could also benefit other regions.

- The development of gas technologies will make it possible to extend the fields of application of the use of natural gas and to substantially reduce the cost of using this form of energy. Québec therefore heartily approves of the signing of technology transfer agreements similar to those recently signed between Gaz Métropolitain, Gaz de France and Osaka Gas. Similarly, collaboration agreements between Gaz Métropolitain and certain Québec universities will facilitate the adoption and adaptation of these technologies. The development of proven gas technologies has, moreover, produced direct spinoffs in Québec since equipment, such as modular gas equipment, intended for the entire American market is now manufactured in Québec.

- Overall, Québec has access to natural gas from western Canada at conditions that are at least as favorable as those of neighboring northeastern American states. Québec can thus attract gas-consuming, energy-intensive enterprises. The government firmly intends to exploit every possibility that will arise and to consider natural gas as one of Québec's true energy assets.

Advanced gas technology: a metal-heating furnace.

Photo: Gaz Métropolitain inc.

SOQUIP

One of the means of the Québec government to reach its objectives in the energy sector is the Société québécoise d'initiatives pétrolières (SOQUIP). Its field of action covers all the economic activities related to fossil fuels, from exploration to the marketing of products. The partnership between SOQUIP and private enterprise allows the government to encourage the launching of energy projects likely to foster Québec's economic development.

Thus, in the Soligaz project, SOQUIP has gathered separate private and public parties to develop and promote an operation that is essential to the consolidation and expansion of Montréal's petrochemical industry. In the oil sector, SOQUIP is also interested in other projects, such as the construction of an octane enhancer plant (MTBE).

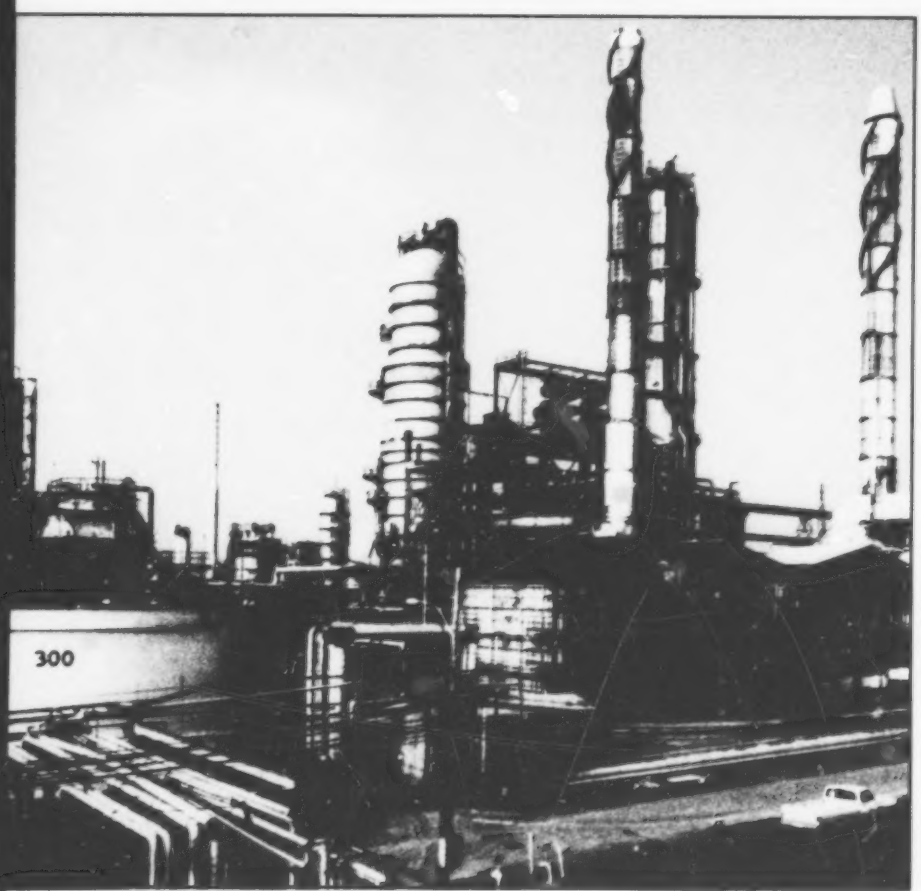
Furthermore, in the natural gas sector, SOQUIP is a shareholder in the Noverco company, which controls the essential part of gas distribution activities in Québec. SOQUIP thus contributes to the development of a major fossil fuel enterprise, which consists of Québec private and public interests and holds substantial financial resources. The collaboration between SOQUIP and Noverco is an important asset for the government's economic action. The inroads made by natural gas in Québec is a good example of the role played by these two companies.

Furthermore, in the natural gas industry, SOQUIP is also an important shareholder in the Sceptre Resources company. This firm has fossil fuel deposits in western Canada and, in 1987, ranked fifteenth in terms of output and reserves among independent Canadian enterprises operating in the fossil fuel sector. SOQUIP's involvement in western Canada helps to ensure Québec's access to stable and competitive natural gas supplies. It confirms Québec's interest in natural gas and allows the government to have a "window" on this field of activity, which can only facilitate the implementation of projects by combining the interests of producers and users.

OIL AND PETROCHEMICALS

- **Refining**
- **Petrochemicals**
- **Distribution of Petroleum Products**
- **Supplies**

In fifteen years, oil lost its predominant role in Québec. However, it still occupies an essential place on the Québec energy market. Oil remains an indispensable source of energy in the transportation sector, where it is not expected that other forms of energy will replace it in the medium term. Its contribution to the requirements of the industrial, commercial and residential sectors is important, and it will remain so at least for the industrial market. Beyond the energy sector, oil and liquified petroleum gases (propane and butane) are used as feedstocks by the petrochemical industry. They thus play a strategic role in an important part of Québec's industrial structure.



The evolution of the oil sector remains, therefore, an important aspect of Québec's energy policy. To act, the government must take into consideration the realities particular to the sector: more than any other area of energy activity, the oil industry is ruled by free enterprise, open to international markets and directly subject to the hazards of competition. The levers of government decision are for the most part under the control of the federal government. The very magnitude of the investments involved limit the role of the State. However, the means of action available to the provincial government are genuine. As a public authority, the Québec government has special jurisdiction in the distribution of petroleum products and with respect to supplies. Through SOQUIP, it can act as promoter or catalyst for private business and encourage parties to take action in the direction it deems advisable. Considering what is at stake, these means of action must be fully utilized.

Refining

Decline, Structural Changes in Demand, and Deregulation

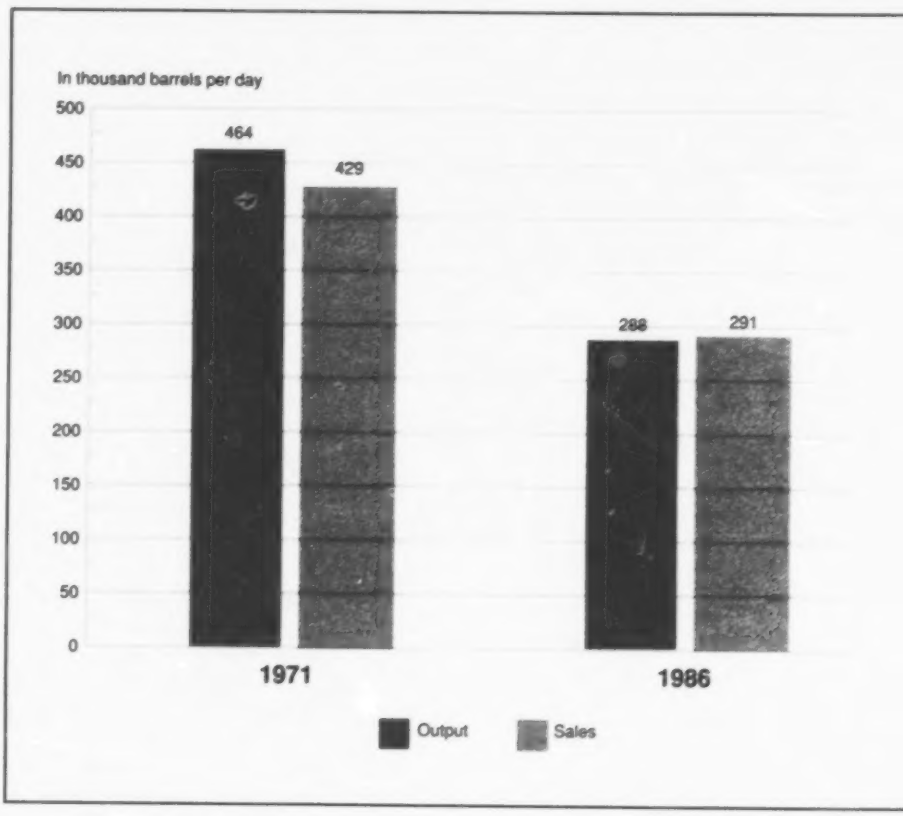
In recent years, the refining sector has undergone many important changes. Beginning in 1982, the oil industry began to react to reduced demand for petroleum products by rationalizing operations across Canada. This action especially affected Québec, where four refineries were shut down between 1982 an 1985, reducing capacity by nearly 40%. In fact, proportionally, the reduced capacity fell below the total reduction in demand for petroleum products in Québec. With the closing of the Gulf refinery, Québec suddenly went from a position of net exporter of finished products to one of importer.

The drop in demand affected various products in different ways. Thus, between 1971 and 1986, the demand structure of petro-

leum energy products was greatly altered. The share of gasoline rose sharply, from 26% to 43%. Inversely, the share of heavy fuel oil fell from 32% to 13%, while the share of medium distillates remained nearly unchanged at 42% in 1986, compared to 40% in 1971.

The opening up of the Canadian market, in the wake of the deregulation of petroleum product imports, also greatly affected the refining industry. The Québec market has always imported considerable quantities of petroleum products from the world market. These imports, however, have risen sharply over the past four years.

Graph 22
Output and Sales of Petroleum Products in Québec
1971 - 1986 (in thousand barrels per day)



Source: Statistics Canada, Catalog 45-004.

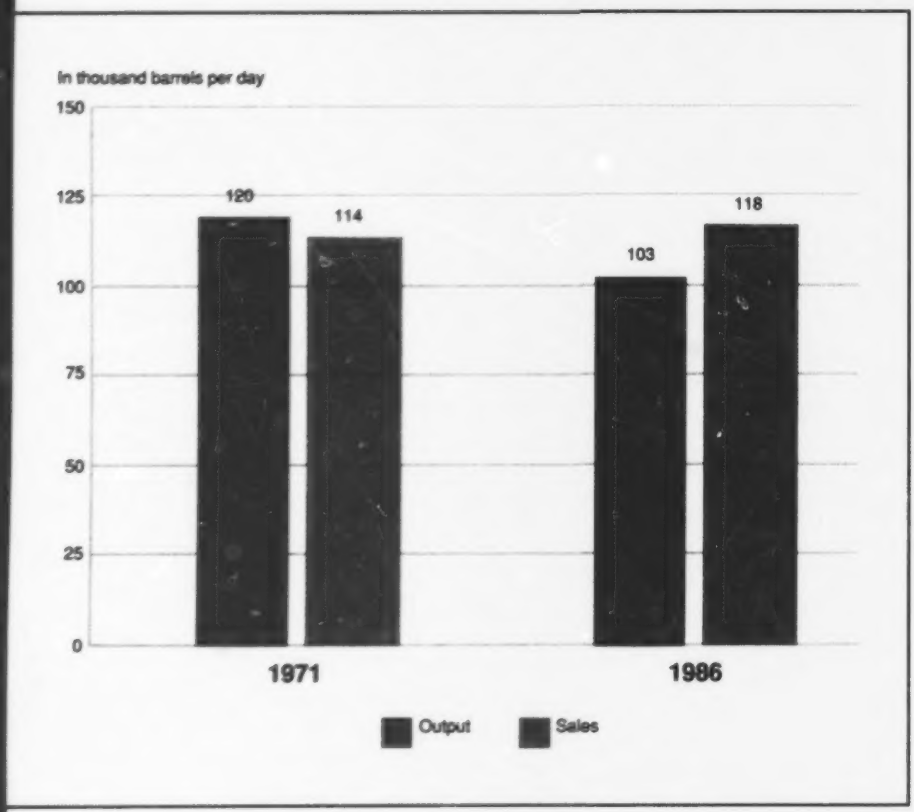
Restored Margins and Outlook for the Future

In the past two years, the situation appears to have become more favorable for the Québec refining industry. In the early 1980s, increased crude oil prices had led to a significant cut in the margin of refiners. The recent drop in prices, combined with the rationalization of operations and a rise in the rate of utilization, has restored the margin of refiners, improving the profitability of the downstream sector of the oil industry and generating important cash flows.

The outlook for change in the overall demand for petroleum products is also more promising for the industry. Although demand for light fuel oil is still expected to fall significantly, this shortfall should be compensated by the stabilization or the growth of gasoline and heavy oil consumption. Another favorable change is the Free Trade Agreement between Canada and the United States, which provides for the repeal, in the coming years, of custom duties levied by the United States on Canadian exports of petroleum products. Thus, the possibility of increasing exports to the American market should be strengthened.

This outlook, combined with higher profits generated by the drop in oil prices, points to a period of consolidation for the refining industry. Refiners should be in a better position to face competing imports, recapture the domestic market and even increase exports. However, this presupposes that the industry continues to invest in order to adapt to the changes in the demand structure.

Graph 23
Output and Sales of Gasoline in Québec 1971 - 1986 (in thousand barrels per day)



Source: Statistics Canada, Catalog 45-004.

Assessment and Orientations

Over the past two years, government action has been aimed at preserving Québec's refining capacity at a level at least capable of meeting demand in Québec. The government has thus opposed the closing of the Gulf refinery in Montréal's east end. It has granted many tax reductions to encourage investments enabling the industry to adjust to market conditions. Collaboration between government and industry has increased. An illustration of this is the updating of all the regulations respecting the safety of oil facilities.

The Québec government will continue supporting the refining industry. The consolidation and expansion of the industry must be fostered. In the last budget, tax breaks were granted to ensure the ability of Québec refiners to compete. Moreover, specific measures were aimed directly at encouraging investments for the construction of an octane enrichment plant.

In the coming years, the Canadian refining industry will indeed be faced with the application of stricter environmental requirements regarding gasoline. These requirements will aim at totally eliminating lead from gasoline and reducing all the polluting effects of this fuel, among which are exhaust fumes and hydrocarbon vapors. The industry is also considering a number of solutions to comply with these requirements: using alcohol and cosolvents; adding a product using light fractions, namely, methyl tertiary butyl ether (MTBE); or recycling at the refinery. Some of these solutions will demand major investments that will be speeded up by an already given tax rebate.

Because of important industrial spinoffs, the Québec government is actively seeking to introduce these new oil-related activities and will set up the means to do so. The introduction of these activities would provide Québec with a new type of production, increase the availability of products in Montréal, and could encourage the trading of refinery and petrochemical products between Sarnia and Montréal.

Petrochemicals

A Very Sensitive Sector of Activity

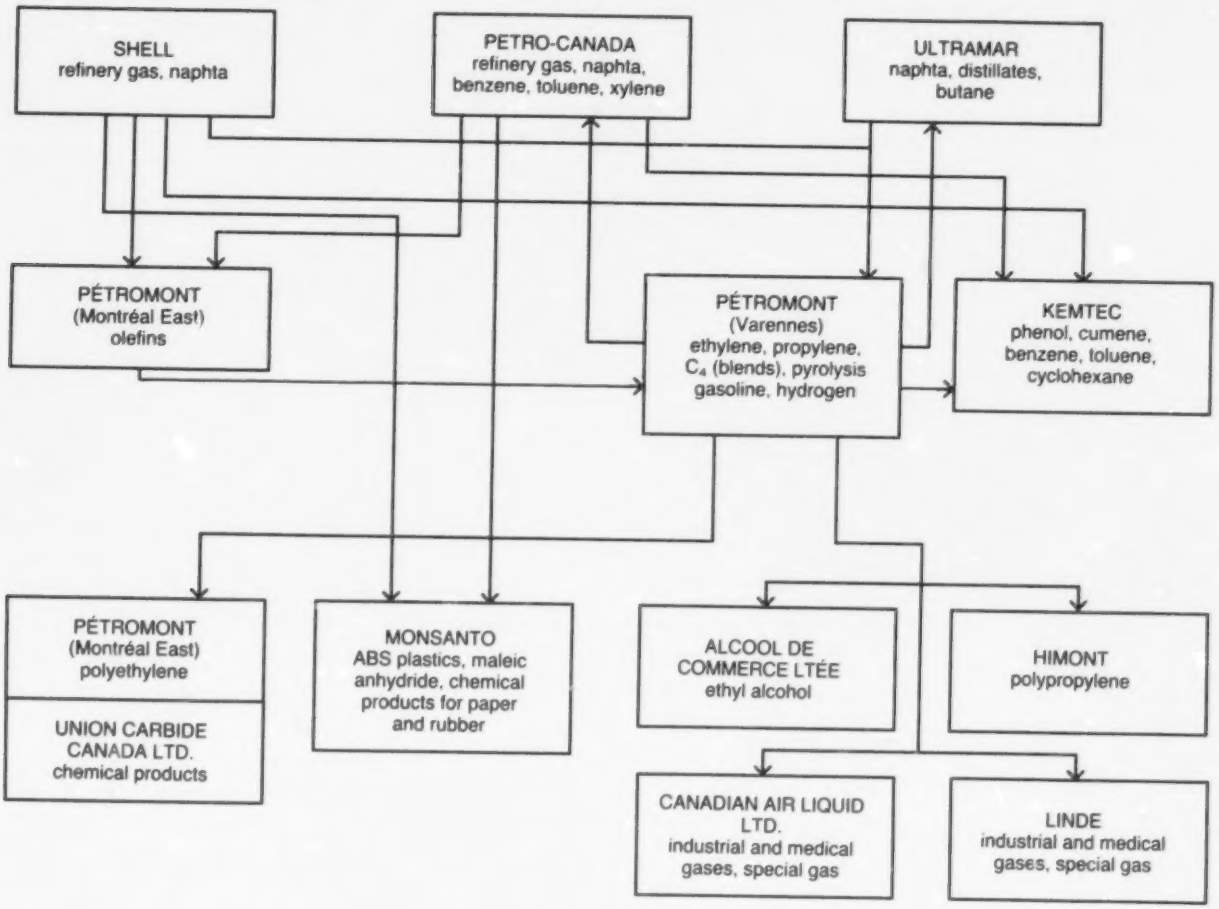
Strictly speaking, the petrochemical industry is not an "energy" industry, but it does use fossil fuels as feedstock. That is why the availability and the price of fossil fuels that affect the manufacturing process of petrochemical by-products are of crucial importance to this transformation industry. The Québec petrochemical industry uses products from oil refining (refinery gases, naphta and aromatic cuts) as well as natural gas (natural gas proper and natural gas liquids).

The successive transformations of fossil fuels into petrochemical feedstocks, then into intermediate and finished products, constitute an industry with a very high value added, whose impact on the balance of trade and on employment is major. In Québec, the petrochemical industry represents 600 enterprises whose development has been very closely tied to the refining industry. In the past, an important group of refineries in Montréal's east end produced light fractions — basically gases from refining, and naphta - which had proven useful to a growing petrochemical industry.

However, four successive refinery shutdowns in Montréal's east end have led to an substantial reduction in the quantities of available products for the manufacture of petrochemical feedstocks, particularly liquified petroleum gas (LPG). This situation contributed to make the economic and financial viability of the petrochemical feedstocks manufacturing industry even more problematical. For the Québec and federal governments alike, the viability of the entire primary, secondary and tertiary petrochemical industry presupposes the continued capacity to manufacture petrochemical feedstocks in the Montréal region. The commitment of the Québec government has been very firm in this respect.

The strategy adopted has been to make the Pétromont plant more flexible with respect to fossil fuel supplies. The Pétromont corporation has thus made important investments to adjust to these major changes in its supplies. New facilities have been installed, which have led to very substantial savings in operating costs. Pétromont's profitability, and therefore of the entire petrochemical industry, has clearly improved as a result of these actions.

Flow Chart of the Petrochemical Industry in Québec



Petrochemical products

- Chemical products industry
- Plastics industry
- Paint and varnish industry
- Welding
- Synthetic textile industries
- Pigment and color industry
- Synthetic rubber industry
- Pharmaceutical and medical products industry
- Soap and cleansing products industry
- Industrial chemical products industry

Orientations: the Soligaz Project

The development of the petrochemical industry is a major element of economic development, and one of the main sources of investments and job creation. The continuation and expansion of the manufacturing of petrochemical feedstocks are essential to the growth of the entire industry, especially as regards secondary and tertiary transformation.

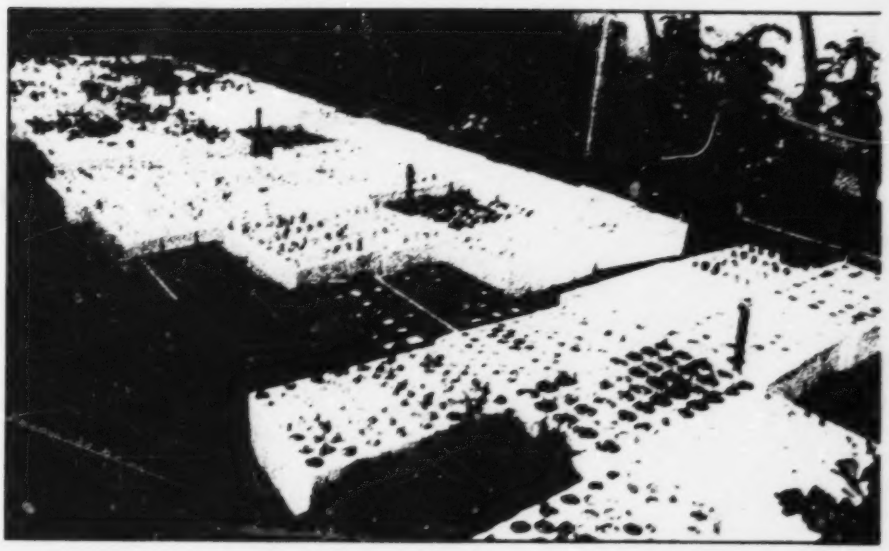
Pétromont, which is the major manufacturer of petrochemical stocks in Québec, must have access, at prices at least as advantageous as those on external markets, to all necessary sources of fossil fuel supplies. A greater diversity of supply sources will make it possible for the transformation industry producing finished products to remain competitive and reduce production costs.

Accordingly, the Québec government will intervene before other levels of government to ensure that Québec consumers continue to have access to oil and natural gas at competitive prices. It will also seek to encourage the development of an economical and permanent network for the storage and transportation of petrochemicals, a network that would be as flexible as possible regarding supply sources.

Government action will deal with all of the following: harbor infrastructures (as a complement to other facilities) to receive supply loads purchased on the world market; the possibility of storing large volumes of fossil fuels (either natural gas, natural gas liquids, propane, butane or naphta); and infrastructures for transportation by pipeline. This will increase the availability of supply loads and reduce their cost price.

To this end, the government has already

Photo: Hydro-Quebec



Petrochemicals, the stuff of everyday goods.

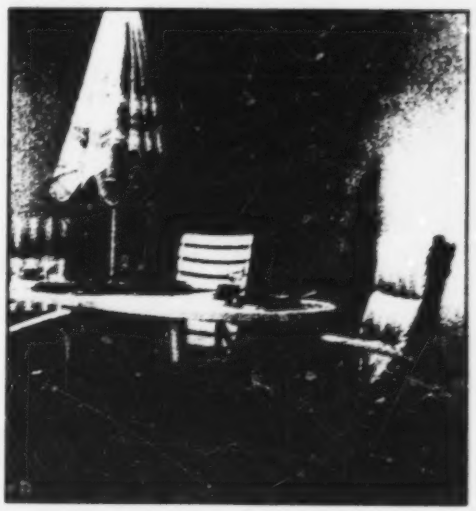


Photo: François Boulay

mandated SOQUIP to promote and develop the Soligaz project in a joint venture with other private and public parties. The implementation of the Soligaz project will constitute one of the most constructive measures for the future of the petrochemical industry in Québec. With respect to energy, once the Soligaz project is completed, Québec will possess facilities allowing it to receive a full range of fossil fuels (oil, natural gas and natural gas liquids) at competitive prices. According to the mode of execution of the project, Soligaz could contribute in a positive way to the maintenance of the Sarnia-Montréal section of the oil pipeline, which supplies Montréal with crude oil from western Canada. The implementation of Soligaz would entail direct investments that could amount to 300 million dollars.

But it is at the level of downstream investments that the spinoffs from Soligaz are most promising. Indeed, Soligaz would attract direct investments in the order of one billion dollars in the short and medium term in the Montréal region, in products such as methyl tertiary butyl ether (MTBE), vinyl bichloride, ethylene and, indirectly, nitro-fertilizers.

For the Québec government, the Soligaz project is one of the most effective means of ensuring supplies to the petrochemical industry at competitive prices. To do so, it will use the various means at its disposal to foster the implementation of the project, with regard to supplies as well as to the development of the markets that will be served. In this respect, the government expects to offer advantages for the use of propane as a fuel that are comparable to those granted natural gas for vehicles.

The Soligaz Project

The Soligaz Project is aimed at supplying Montréal with natural gas liquids (NGL) from Alberta. The plan includes purchasing and collecting NGL in Alberta, transporting them to Montréal by oil pipeline, and fractionating the NGL (propane, butane, isobutane) in Montréal.

The project calls for either the conversion of the IPL oil pipeline between Sarnia and Montréal, or the construction of a new pipeline to carry NGL blends from western Canada. The benefit of the project stems from the reduction of transportation costs of NGL from Sarnia to Montréal. This cost reduction would increase Montréal's economic security and flexibility of supplies in fossil fuels since western NGL, shipped by pipeline, now stop at Sarnia. With Soligaz, Québec would add NGL to its fossil fuel supplies carried by pipeline, which would allow it to rely on a complete range of fossil fuels (oil, natural gas and natural gas liquids).

Moreover, Soligaz is considering the possibility of providing Montréal with the infrastructures necessary to import natural gas liquids from abroad. These infrastructures would include harbor developments and underground storage tanks.

The overall objective is to enable Montréal's petrochemical industry to become more competitive so it can begin to trade on new markets.

Distribution of Petroleum Products

Concerning the distribution of petroleum products, considerable structural changes have affected the level of competition on various markets. The reduction in the number of refineries, the merger of distribution networks and the drop in the number of fuel retail outlets have prompted the government to act in specific ways.

In December 1985, the government decided to reduce by 4.8¢ a liter the fuel tax in outlying regions, to enable the regional populations concerned to benefit from prices similar to those paid in Montréal, Québec City and other central regions. These cuts are always in effect and have even been extended to certain specific regions, most recently in western Québec. It was subsequently shown that the full benefit of this measure, which nevertheless cost the government nearly 50 million dollars a year, had not been passed on to consumers. Having no other option than to introduce a corrective measure, the government ordered price ceilings so that consumers could receive what they were entitled to.

A parliamentary commission, held in September 1987 at the end of the period of application of these government orders in council, finally led to the emergence of a consensus on the price of gasoline among all the parties concerned. On the one hand, all recognized the advantages of competition when it is allowed full sway; on the other, many parties said they were ill-informed as to the true prices and the logic of the costs that justify them.

It is in this spirit that the Bureau d'inspection et d'information du prix de l'essence (BIPE) was created. The creation of this body reaffirms that the free play of competition and market forces is the best way to set "fair and reasonable" prices, while emphasizing that this approach has certain limitations. Indeed, not all markets are open to the same level of competition. This weakness must be compensated by enlightened and specific information. The BIPE's mandate is to offer consumers the tools to better analyze the state of their respective markets in order to pressure, if necessary, the oil industry and ensure true competition.

The monthly BIPE Newsletter, informs consumers in outlying regions on the "truth about prices" of the main fuels.

Supplies

Access to Canadian Resources: a Priority

For slightly more than ten years, Québec has had permanent and economical access to oil resources in western Canada. This access, made possible by the construction of the Sarnia-Montréal pipeline, has profoundly transformed the Québec energy situation. Québec has been able to significantly reduce its dependence on the world market, thus reinforcing it security of supplies. It has paid a large part of its oil bill in Canadian cur-

The Bureau d'inspection et d'information du prix de l'essence (BIPE)

Beginning in December 1985, the government has intervened a number of times with respect to gasoline prices. First, it significantly reduced the fuel tax in outlying regions in order to enable consumers in the regions concerned to benefit from prices at the pump that were comparable to those of large centers. Through this action, the government intended to both lessen interregional disparities and indicate unequivocally to the oil industry that it considered fuel prices to have strategic importance in Québec.

It is in this context that must be understood the corrective action undertaken by the government when it decided to temporarily order price ceilings in outlying regions. In effect, it needed to ensure that the full benefit of a 50 million-dollar tax reduction it had injected into the regional economy was really passed on to those for whom the tax cut was intended, and not misappropriated by certain private interests.

While the government orders were an emergency measure, temporary and well defined in time, the creation of the Bureau d'inspection et d'information du prix de l'essence (BIPE) gave a permanent character to government policies concerning fuel prices in Québec's outlying regions.

With the BIPE, the government upholds the free exercise of competition with respect to fuel distribution. At the same time, it gives populations less likely to benefit from this competition the assurance that they will be in a position to know market conditions and real costs. The BIPE is not a "Price Control Board"-type of regulatory agency. By creating it, the government relies first and foremost on the full exercise of competition based on the direct action of consumers on the forces at work in the various markets.

rency, which has had a very positive impact on the Canadian balance of payments.

Actual forecasts concerning Canadian light oil supplies indicate a significant reduction in the availability of oil from western Canada in the early 1990s. Indeed, according to various price scenarios, it is possible that, beyond 1991 or 1992, western Canada's light oil capacity will only be enough to meet demand in the Prairie Provinces, Ontario and British Columbia. These difficulties, however, should end by the end of the 1990s, with the development of new sources of crude oil. In recent years, there has been an important drop of the share of Canadian oil in Québec's total oil supplies. This situation is explained especially by the strength of international competition and the removal of federal government controls on short-term light and heavy oil exports.

It is necessary that Québec continue to have priority access to Canadian oil sources in case new situations of supply shortages occur on the international market. The Free Trade Agreement between Canada and the United States gives the federal government the possibility of guaranteeing such access, should the need arise. The Québec government will intervene in this matter before the governments concerned.

To resolve the problem of the physical availability of oil, the production of Canadian supplies must be encouraged and stimulated. A number of projects to produce synthetic oil and promote enhanced recovery, or again to develop the Beaufort Sea deposits and those off the coast of Newfoundland could, in the not too distant future, raise Canadian production to a level that would be enough to meet part of the Québec demand for light oil. However, uncertainty in price changes have called into question the implementation of these projects in the near future. But their implementation is very important for the security of supplies of the Québec economy. The Québec government plans to collaborate with the federal government and those of the producer provinces to carry out economically profitable projects.

This does not mean that the Québec government supports the setting of a floor price for Canadian oil. The Québec government wishes to make it clear that it favors a policy of "truth about prices" on this score. It will intervene at every opportunity before other levels of government in Canada to maintain Québec's access to oil and NGL at prices compatible with those on international markets.

Access Routes

Three major pipelines are use by Québec's oil industry: the Sarnia-Montréal and Montréal-Portland oil pipelines for crude oil, and the TransNorthern oil pipeline for petroleum products.

In 1976, the construction and start-up of the Sarnia-Montréal oil pipeline gave Québec direct physical access to oil resources in western Canada and the United States. Actual forecasts of changes in supply and demand of Canadian oil could once again call into question the economic viability of this part of the interprovincial pipeline and give credence to speculation about its shutdown or reversal. For Québec, this possibility must be firmly opposed. Its effect on the flexibility of supplies and on competition could only mean the deterioration of Québec's energy security.

Moreover, Québec has already stated its position before the NEB on this matter many times, emphasizing the vital character of an access route to Canadian oil. In August 1987, it obtained recognition of the urgency of the situation from the annual Conference of Energy Ministers. Following the conference, a committee composed of representatives from the governments of Ontario, Alberta and Québec as well as from the federal government were appointed to study the best means of guaranteeing oil supplies to central Canada and maintaining the infrastructure of the pipelines.

Québec is relying on the concerted action of the various governments concerned to see that the west-east utilization of the Sarnia-Montréal oil pipeline handles enough traffic to ensure its viability. There are a number of solutions. One of them is that partial supplies from the United States would satisfy the interests of all consumer and producer

provinces. In the coming months, the government will endeavor to facilitate such concerted action.

Keeping the Portland-Montréal oil pipeline in operation, which allows Montréal refineries to obtain imported oil supplies without the shortcomings of river transportation, also constitutes a priority. This pipeline simplifies supplying Montréal's refining center, and makes it more economical. Since the fall of 1987, the partial conversion of the Portland-Montréal oil pipeline to carry natural gas has helped strengthen its economic viability.

Storage

The situation of net importer of oil and petroleum products, which could be that of Canada in the coming years, will probably lead to considering the necessity of acquiring storage capacity in order to comply with the standards of the International Energy Agency (IEA) concerning security of supplies. According to these standards, importer countries must keep reserves equivalent to 90 days of net imports in their storage tanks. This quantity is considered by the Agency to be enough to cope with the more difficult situations.

Already, Canadian oil companies keep in refineries, in the form of crude oil or petroleum products, large stocks of fossil fuels in order to comply in part to this criterion. But the building up of additional contingency stocks should be considered. However, to build up such reserves is a matter concerning the federal government, as it has jurisdiction in affairs of national security.

Oil storage can be considered only a short-term measure to improve energy security. Preserving transportation infrastructures and developing Canadian resources remain in the medium and long term the only valid option to reinforce security of oil supplies.

Distribution mechanisms exist on an international basis between member countries of the International Energy Agency and on a national basis through the Energy Supplies Allocation Board. These bodies seek to ensure an equitable sharing of supplies in emergency situations. Québec continues to participate at its level in such organizations and relies on their continued existence. For its part and in a complementary way, the Québec government will enact the necessary legislation to apply its own demand restraint program in emergency situations. Discussions to coordinate this program with that of neighboring governments are being pursued.

ENERGY EFFICIENCY AND DIVERSITY

- **The Road Traveled, Outlook for the Future**
- **Assessment of the Past Two Years**
- **Guiding Principles and Means of Action**

What is meant by "energy efficiency and diversity"? As it stands, the expression has a wide meaning. It means to put various techniques to produce, transform and utilize all the many energy resources at the service of the population. Indeed, with this concept, emphasis is placed on two specific aspects of the energy sector, namely, activities aimed at increasing the efficiency of energy consumption and efforts to promote alternative forms of energy. In both cases, one is in the presence of areas of operation where resources are relatively difficult to mobilize, where results are often evaluated over long periods of time, where even the quantification of phenomena is a delicate process, but where the stakes involved confer on the government a special responsibility.

The Québec government has explicitly chosen greater energy efficiency and diversity as one of the objectives of its energy policy. Indeed, in many respects, it represents an insurance policy against the hazards of the international energy situation. It enables Québec to reduce its dependence on imported fossil fuels. It is often a low cost alternative to the production of conventional energy forms. It leads to important investments and to job creation in a relatively decentralized way. It gives worth on site to natural resources available in various localities. More efficient use of energy has on the environment a beneficial impact that should not be underestimated. The development of alternative energy forms can constitute a partial solution to pollution problems in urban and rural environments alike. Last, and perhaps above all, it ensures productivity and the increased competitiveness of our enterprises.

Energy Efficiency

Spectacular Results

In Québec, considerable progress has been made regarding energy efficiency. Until the early 1970s, the rate of increase of Québec energy consumption was closely linked to that of the entire domestic production. During the 1970s and 1980s, this link was broken in Québec as in all industrialized countries. In 1986, Québec consumed about the same quantity of energy as in 1971. In terms of consumption per thousand dollars of production, Québec improved its energy efficiency index by 30% over the past fifteen years.

Such progress was made especially in the transportation and residential sectors. From 1971 and 1986, average consumption per motor vehicle fell by more than 30%. Very strong reductions were recorded in vehicles for personal use and lesser reductions, although important one, in public transportation and the transportation of goods. Owing especially to better insulation and improved equipment, the residential sector experienced a reduction of more than one third in the average consumption per household over the same period. It is difficult to determine with a high degree of precision the gains made in energy efficiency, but it can be noted that in the two sectors representing the greater part of the energy consumption of individuals, the reduction in energy consumption was very substantial.

The Role of Government Policies

Government assistance and information programs, tax measures and regulations all explain to some extent the results recorded. However, these results are primarily attributable to the reactions caused by the rapid rise in energy prices. Interventions rein-

forced one another, and it is impossible to say what would have occurred in the absence of one or the other. The objective of the governments, which was to help consumers react to sudden energy price hikes, has been attained.

The importance of the effort made as early as 1975 through government assistance programs was justified by the suddenness of the energy crisis. Subsequently, government intervention followed a different course. It consisted instead in information and awareness programs, and in increased regulations.

In the transportation sector, the results obtained are explained in part by the prompt replacement of vehicles. The American government imposed strict regulations on car manufacturers in terms of the average consumption of the vehicles produced. As the automobiles then in circulation were gradually replaced, the effects of these regulations, endorsed by the Canadian government, were quickly felt.

Also, from an energy standpoint, regulations respecting energy efficiency standards in housing constructions have already radically altered the way houses are built in Québec. However, these regulations have been successful only inasmuch as builders and consumers were sensitive to energy conservation, as a result of price increases as well as information campaigns sponsored by both the government and the private sector.

Outlook

Maintaining existing regulations should ensure that the gap in the remaining energy efficiency potential will gradually be closed as automobiles currently in circulation are gradually taken off the road, and older houses are either replaced or renovated. Consumers are now well aware of these questions and have had time to modify their behavior and choose new equipment in line with their personal preferences. The context of prices is, however, radically different from the one that prevailed in the early 1970s. The drop in the prices of fossil fuels has weakened the resolve to save energy. However, the instability of energy markets should inspire caution, and the government should endeavor to keep consumer interest focused on this subject.

The Industrial Sector: a Special Opportunity

In the industrial sector, progress has been slower. Between 1971 and 1986, energy consumption per production dollar declined only by about 10%. This is probably explained in part by technical reasons. The life span of equipment leads to spreading over long periods of time the adoption of more energy efficient techniques. The industrial sector covers very many activities where government incentives must be tailored and targeted.

In the coming years, the stakes will be high. The improvement of energy efficiency has a direct bearing on the ability of enterprises to compete, and it especially affects energy-intensive industries, which are also export industries in Québec. While international competition is increasing and the Free Trade Agreement between Canada and the United States reinforces that competition, a better use of energy can constitute a very precious asset for Québec companies. In the life of enterprises, energy efficiency has other advantages: adopting more efficient processes often means a better quality of life in the workplace; it also leads to the increased flexibility of manufacturing processes and to superior production standards.

Over the next twenty years, it is estimated that nearly 30% of the expected savings in energy will come from the industrial sector. For the government, the goal is to ensure this improvement in energy efficiency and hasten its implementation. In a context of moderate energy prices, the challenge is great. Given the expected impact on both energy costs and industrial apparatus, a large part of future efforts will have to be directed towards this challenge.

A Sector of Activities Creating Jobs and Investments

Seeking greater energy efficiency translates into modified behavior, but also and especially into investments, such as the renovation of buildings and the purchase of new equipment. The lever or multiplier effect of government investments in favor of energy efficiency has to date proven to be very high in the private sector.

Improving industry's energy efficiency by identifying potential energy conservation areas.

The impact of the energy productivity program of the Bureau de l'efficacité énergétique of the ministère de l'Énergie et des Ressources (BEÉ), which has affected only a limited number of companies, illustrates this situation very well. Over a five-year period, the program, which cost the government four million dollars, has prompted investments of 155 million dollars, with annual energy savings of approximately 74 million dollars for a two-year period of recovery of investments. It has contributed to the creation of jobs for nearly 4,000 person-years and brought in revenues for the Québec government totaling some 30 million dollars. In Québec, it is estimated that 2,400 direct and indirect jobs are related to the energy efficiency industry. In addition, energy management has sparked the creation of new expertise within companies as well as in a great number of consulting firms.

Alternative Energy Sources

The Current Situation

Although it is difficult to obtain precise figures, it is estimated that the contribution of alternative energy sources to Québec's energy balance has risen from 4% to 9% between 1971 and 1986. This estimate includes only forest and urban biomass (the combustion of wood and urban waste, and the use of firewood in dwellings).

The development of other alternative sources of energy has met with less success and, in most cases, has been limited to research. The low cost of electricity in Québec creates a threshold of profitability that is difficult to cross for a great many of these energy sources. In Québec, they must also have reached a high level of development before they can be exploited on a commercial basis.

In the actual context of low energy prices, the significance of continuing government action in these sectors stems from long-term considerations. Québec industries must remain involved in the development of technologies and alternative energy sources in order to take full advantage of the progress expected in this area. In Québec, there does exist a viable alternative energy industry, which is likely to expand somewhat. With respect to services and expertise, technologies and alternative energy forms can rely on very important potential export markets. In municipalities, alternative energy forms could eventually solve important environmental problems in an economically acceptable way. These technologies also offer new solutions to problems concerning the elimination of old tires and wood residues.

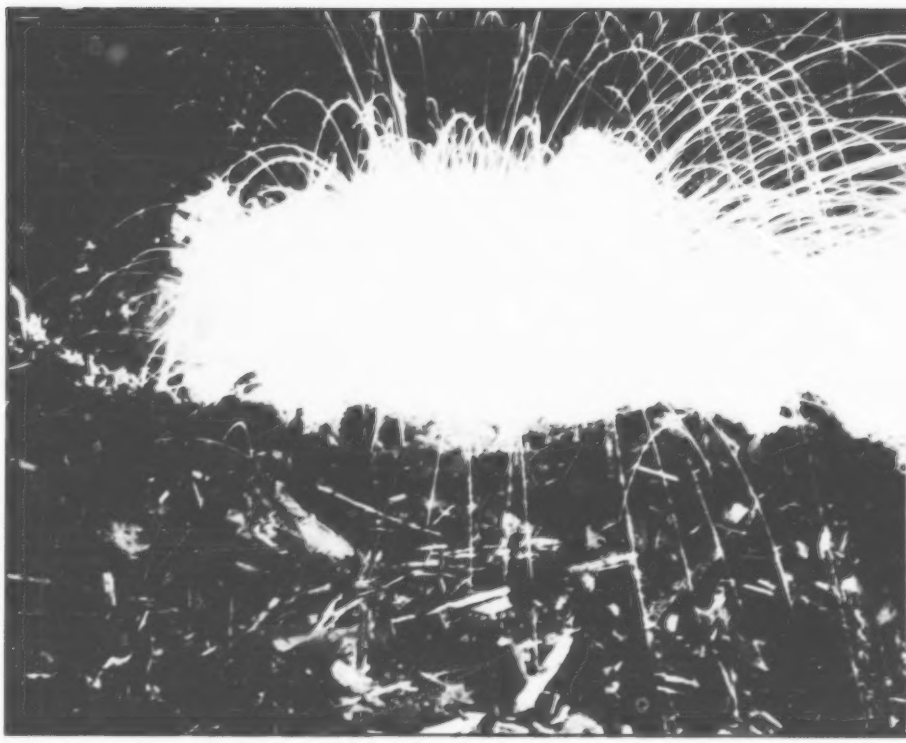


Photo: Québec Forest Industries Association

Outlook

The outlook for the increased contribution of alternative energy sources to the energy balance remains limited. In the coming years, urban and forest biomass will probably progress slightly. As for other forms of energy, however, only long-term progress is expected, which assigns the government the task of supporting research and development.

The production of alternate fuel continues to represent real interest for Québec because of the almost total monopoly of petroleum products in the transportation sector. However, in this field, we are still looking for a technology to produce an alternate fuel from Québec resources at competitive prices.

The development of the technology to produce hydrogen from electrolysis is a separate case. Strictly speaking, it does not involve the development of alternative energy forms, but rather of an energy vector to transport and store electric energy. Hydrogen technology also presents an additional industrial interest, particularly because of its role in the chemical and metallurgic industry.

Assessment of the Past Two Years

Energy Efficiency

Over the past two years, the government has emphasized action in the industrial sector, thus demonstrating the importance it gives to energy efficiency and its impact on the profitability of enterprises.

In addition to running energy tests, which have identified, in nearly five hundred companies in the industrial and commercial sectors, a $70,000,000 energy-improvement potential, the government has granted more than two million dollars to engineering consulting firms to conduct feasibility studies on measures to save energy.

Moreover, the government has sought to facilitate technology transfers through shows and expositions as well as by demonstration projects and the publication of technical guidebooks.

Finally, the government has supported the creation of the Association québécoise pour la maîtrise de l'énergie (AQME), an association that groups many energy experts from major Québec companies as well as manufacturers of energy efficiency equipment and consulting firms involved in this area.

These actions in the industrial sector have been accompanied by the pursuit of information and awareness activities intended for other sectors of consumption. A large-scale training program entitled "Energy Efficiency Expert" has been prepared for the multifamily housing renovation sector.

Alternative Energy Forms

Concerning alternative energy sources, the government has shown interest in the recovery of energy from urban waste by taking part in a number of feasibility studies on Energy from Waste plants (EFW). The government has granted financial assistance for the construction of a pilot project, an EFW plant to recover energy from old tires.

As regards hydrogen, the government has helped the Conseil de l'industrie de l'hydrogène finance its operations and implement a number of projects. In recent years, two hydrogen production plants have been built in the Bécancour industrial park (Oxychem and HydrogenAL), and a plant to produce liquid hydrogen in Magog (Airco).

Between 1986 and 1988, assistance to alternative energy forms as well as to energy efficiency has been financed under a special federal-provincial agreement. This agreement coordinates the services offered by the two governments in this field. A single "counter" has been made available to the parties concerned. The agreement and other actions taken have led the Québec government to devote slightly more than 12 million dollars over two years to energy efficiency and diversity.

Québec's solar energy industry, also supported by government action, occupies an important place in Canada. Partly owing to the large number of projects carried out with government assistance, the INRS-Énergie has become one of the leading solar energy centers in Canada. Because of the almost exclusive dependence of the transportation sector on petroleum products, the government has also granted assistance to development projects in the technology of alcohol fuel production from forest biomass.

Guiding Principles and Means of Action

Principles

Government action regarding energy efficiency and diversity is based on a few guiding principles:

- The planning of integrated technological development or of demonstration activities based on prior research or development work, in preference to scattered efforts;

- The implication and concerted action of the private sector, rather than direct action: this means encouraging through technical and financial support private organizations capable of sharing responsibility in energy matters;

- The implementation of research, development and demonstration projects by specialized private parties;

- The choice of an approach that meets the specific needs of a given clientele.

Actions

Energy potentials must be exploited in sectors where they are highest and economically most profitable.

The most important potential for improving energy efficiency is found *in the industrial and commercial sectors*. It is there that the government will spend the major part of its efforts and resources, emphasizing technological transfers. The government intends to carry on its energy productivity program by offering energy audits free of charge. It will finance part of the cost of feasibility studies required by complex measures. When enough audits and feasibility studies have been made for a sector, an energy guidebook will be published and distributed to companies. A demonstration program will be offered to popularize energy technologies that will have shown technical and economic reliability. In the commercial and institutional sectors, the government will concentrate especially on office buildings and municipalities. Special programs aimed at activities that consume the most electricity will be prepared for the agricultural industry.

In the residential sector, important progress has been registered owing in part to various assistance programs. However, multifamily housing benefited little from them, and existing multifamily lodgings will require important renovation work in the coming years. The government will also see that, through information and training programs as well as assistance programs for demonstrations, the specialized parties concerned are familiar with construction techniques and the availability of materials and with equipment showing a high level of energy-efficiency. The goal is to reach still faster the energy improvement potential that is profitable in the short term.

There is still much room for energy efficiency improvement in housing.

Photo: François Boulay

In the transportation sector, the government intends to pay special attention to the promotion of energy efficiency among municipalities and other parties through demonstration projects and training activities.

In the area of alternative energy forms, the government will seek to speed up the achievement of the technical and economic viability of alternative energy forms now being developed. The main effort will center on research and development and, given substantial contributions from the private sector, on commercial demonstration projects. The government will continue to offer its support to organizations devoted to the promotion of new technologies.

Four areas are likely to rank high in alternative energy production or technological development in the next few years:

- ***The Development of Technologies Linked with Hydrogen as Energy Vector.*** In the area of hydrogen production by water electrolysis, Québec boasts many advantages: advanced technology, abundant hydroelectric resources at favorable rates, industries already involved in this sector as well as reputed laboratories and research centers. The Québec government will partially finance and take part in the management of feasibility studies on the intercontinental transportation of hydrogen. With other partners, it will set up a fund for research at the Masters or Ph.D. levels in hydrogen-related technologies. It will support financially and technically the Conseil de l'industrie de l'hydrogène and will participate in ad hoc projects demonstrating the use of hydrogen as a fuel.

- ***The Recovery of Energy from Urban Waste, Motivated by Environmental and Social Considerations.*** Many municipalities in Québec are seriously considering this solution to solve environmental problems caused by urban waste. Because of the importance of waste for energy and the environment, the government is considering supporting the demonstration of energy-producing techniques using cogeneration or producing vapor from urban waste.

The Bureau de l'efficacité énergétique

Since April 1, 1988, the Bureau des économies d'énergie (BÉÉ) has become the Bureau de l'efficacité énergétique (BEÉ). This new name corresponds better to government intentions to promote the concept of energy efficiency. This concept means using a minimum amount of energy for the maximum output of goods and services.

The basic orientation of the BEÉ is the "technology transfer" of techniques and technologies relating to energy efficiency. This task must be maintained and will be reinforced by the creation, within the BEÉ, of a team responsible for technology transfer. At the same time, various activities such as diagnosis, evaluation, awareness raising, training and education will be pursued—through technical aid and selective financial assistance—with the help of the milieus and parties concerned, who will assume responsibility for these activities when that is deemed possible and effective. Moreover, demonstration activities will be carried on since they are the essential source of information and data in technology transfer.

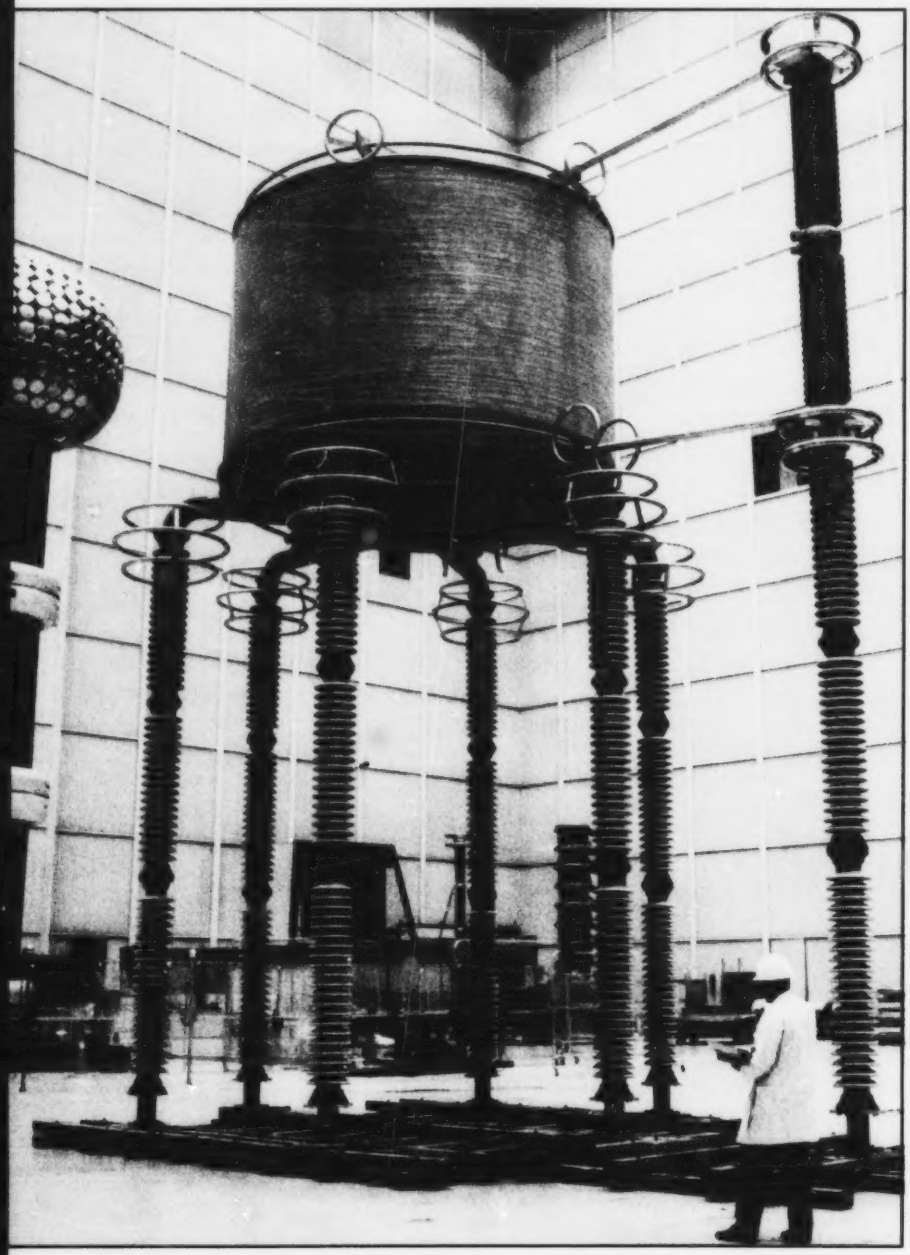
- **The Combustion of Wood Residues in Some Industries**. Natural gas and electricity (special surplus energy tarifs) are the main competitors of wood residues as fuel. However, the main obstacle remains the large amounts of money companies must invest so that their boilers can use this resource. For this reason, the government will encourage the demonstration of conversion techniques to gather pertinent data and ensure the transfer of information to other potential users. At the same time, the government is holding discussions with the Centre québecois de valorisation de la biomasse and the Université de Sherbrooke to set up a technological development program in this sector, a program that is in part based on experience acquired from the Biosyn project.

- ***The Continuation of the Development of Technologies to Produce Alternate Fuels from Forest Biomass***. Government action will focus on research and development. It will continue to collaborate with the Centre de recherche en sylvichimie de l'Outaouais [Outaouais forest chemistry research center] to develop a technology to produce ethanol fuel from wood with poor commercial value.

RESEARCH AND TECHNOLOGICAL DEVELOPMENT

- Technological Changes and the Energy Sector
- The State of Research in Québec
- Government Orientations

Technological Changes and the Energy Sector



In Québec, energy research focuses primarily on the production and transmission of electricity.

Photo: IREQ

Modern and contemporary economic history has been marked by a succession of technological changes. Among these, some of the most important have affected either the use or the production of the various forms of energy. These changes have modified demand shares among energy sources. They have led to an increase in the overall quantity of available energy and improved the well-being of populations. To be convinced of this, one need only recall that the invention of the steam engine combined with the use of coal in the 19th century revolutionized transportation and the manufacturing industry. The development of the combustion engine as well as the appearance of heating equipment using petroleum products enabled oil to progressively replace coal in most uses. Recent years have been characterized by the development of electrical appliances, which have just about changed our whole way of life.

Technological changes have occurred in uses and means of production alike. Often, innovations made use of a relatively abundant and unused resource. Growing utilization and research efforts subsequently focused on reducing production costs and increasing the availability of energy. Efforts to improve the efficiency of appliances have yielded progressively better results from the same quantity of energy. In recent years, considerable research efforts have been exerted to explore and exploit fossil fuel deposits increasingly difficult to reach, and to produce electricity from hydroelectric research or thermonuclear sources.

Technological progress can make the use of a resource more competitive against other forms of energy, create new uses for it or reduce its production costs. Such progress is thus a source of collective wealth and economic development. Québec's interest in research on the production and use of its abundant resources is therefore obvious.

Fields of Research of Interest to Québec

It is clear that progress that extends the use of electricity to various sectors of consumption represent a strategic interest for Québec. Similarly, innovations that help reduce the production and transmission costs of electricity have obvious advantages. Two illustrations can be given. A technology allowing electricity to compete effectively with gasoline in certain motor vehicles, at comparable cost and load, would confer still greater value upon this energy form. Also, the production of hydrogen by water electrolysis would make it possible somehow to store and transport electricity over long distances, thus increasing the number of accessible markets for this energy source.

For other forms of energy, which Québec imports for the most part, greater efficiency of use, distribution or processing presents a relatively important economic interest in the context of increasingly interdependent and open world markets. The deregulation of trade obliges us, indeed, to use the combined resources of capital, manpower, raw material and energy as rationally as possible. In this respect, assistance to research and development constitutes one of the few remaining openings where direct government action is still acceptable.

Technology Transfer, Research and Development

Mere technology transfer sometimes provides the best available solutions at a relatively low cost, provided one can demonstrate the economical operation of processes in the Québec context. In effect, it would often be too expensive and quite pointless to repeat research already done elsewhere, in conditions of energy supplies making such research indispensable.

A true research and development effort in Québec, however, remains essential to discover solutions suitable to the Québec economy. Such effort also enables us to fully participate in the progress of world technology and ensure that our industries adopt the more recent developments in technology at the same pace as in competing economies.

Research also constitutes one of the most effective means of maintaining a good balance between economic development and the protection of the environment. Research is an essential instrument for solving problems as diverse as those related to the construction of dams and hydroelectric power plants, the installation of transmission lines or the reduction of the polluting effect of fossil fuel consumption.

The State of Research in Québec

Production and Transportation: Electricity and Alternative Energy Sources

It is normal that, in Québec, the greatest efforts in energy research be devoted to electricity and the special problems arising from its production from gigantic power plants located at considerable distances from the areas where energy is consumed. Hydro-Québec research centers, in particular the Institut de recherche en électricité du Québec (IREQ), clearly represent the best organized and most important structures in terms of personnel and expenditures in energy research. Hydro-Québec estimates that all its technological development activities will require investments totaling approximately 300 million dollars from 1988 to 1990. More than 40% of this amount will be earmarked for research and development proper, while the remainder will be spent on demonstration projects, tests and simulations.

A large share of the budget is naturally devoted to resolving certain aspects related to some of the company's major programs. This is the case for studies on the construction of a 450 kV direct current line and its underwater crossing. As concerns the environment, major study and research programs place Hydro-Québec among world leaders. Over the long term, Hydro-Québec is interested in areas of basic research: in this respect, its projects focus on nuclear fusion, the production of hydrogen through electrolysis, polymer electrolyte batteries, and superconductivity. Significant breakthroughs in one or the other of these technologies would have important spinoffs not only for the Québec economy, but also for the place electricity would occupy in the world economy.

The concerted action of partners makes it possible to produce greater synergy, as demonstrated by the joint accomplishments of the Conseil de l'industrie de l'hydrogène [hydrogen industry council] and Hydro-Québec. A Canadian center for magnetic fusion integrates activities from Hydro-Québec, Atomic Energy of Canada and the INRS. A consortium has been formed by Hydro-Québec, Atomic Energy of Canada and Canada Wire and Cable to create a high-temperature superconductor to carry electricity over long distances without resistance or loss.

Alternative energy sources, another area of energy production where Québec research is involved, constitute a sector of activity in which, by definition, the role of research and development remain central. Many forms of energy have been the object of important endeavors in recent years. Considerable investments have been earmarked for the gasifying of wood, the processing of waste, the production of electricity from wind power, the use of solar energy and the manufacturing of hydrogen. However, the alternative energy sector is still largely dependent on government assistance in order to progress, and for its research and development financing. In this area, the contribution of the Québec government and its state-owned corporations has been particularly important.

Uses

As for uses, the Laboratoire des technologies électrochimiques et des électrotechnologies (LTÉÉ), launched in July 1987, constitutes a new and important addition. It has been established to promote energy efficiency through the electrification of industrial processes. With this laboratory, Hydro-Québec will have at its disposal an instrument for the demonstration and development of new electric processes, a tool that will facilitate their dissemination on the Québec market. The laboratory's budget is estimated at 30 million dollars for the period 1988-1990. It is financed in part through government assistance under a Canada-Québec agreement.

In the area of natural gas, the increasingly active presence of Noverco at all stages of activity has led to research agreements with the École polytechnique and Concordia University. For the time being, activities in this area are more a question of the transfer of existing technology than of research proper. In this respect, a gas technology documentation center has been created at the École polytechnique. Also, a number of highly promising experiments have been undertaken. The increased penetration of natural gas in the Québec energy balance sheet is tied to the more general mastery of gas technologies and requires the establishment of genuine centers of expertise in Québec.

As for oil, Québec refineries are part of very large Canadian or multinational companies with research centers whose activities are

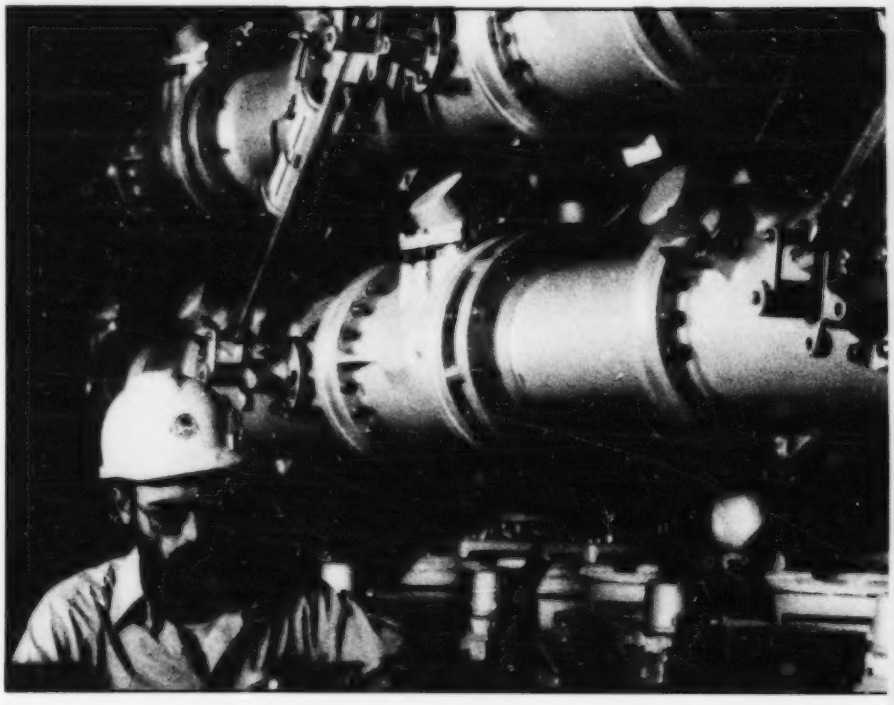
conducted for the most part outside Québec. Petro-Canada's Canmet project, carried out over the past few years, has been an extremely important demonstration activity. Besides this project, there has been little research and development activity in the oil sector in Québec. The lack of important Québec-owned companies has not allowed for significant research and development activities.

With respect to energy efficiency, research is being conducted in a number of private enterprises in collaboration with research centers. The contribution of governments in this area has been limited to financially assisting proposed projects through existing programs. This consists of research in manufacturing processes and in the development of energy efficient equipment or materials. It is difficult to evaluate with precision the amount of research conducted in this sector because of the great number of parties involved. Indeed, just as the improvement of energy efficiency is based on a great deal of individual actions, so research is distributed among companies, research centers and universities. In this field, both the federal and the Québec governments offer support through assistance to existing research and contribute to the dissemination of this research through their programs of information and of assistance to demonstrations. However, there is no centralized structure for research and development in energy efficiency. Another unknown for the future is whether research in energy efficiency will be slowed in the wake of lower fossil fuel prices.

Government Orientations

Research and development is an activity whose benefits are located in a relatively distant future and that is fraught with a high risk level. Only larger companies with long-range planning can take on the responsibilities and costs of this research and development. In the area of traditional energy sources, such companies are found in both the public and private sectors. With limited government assistance, they are able to undertake the required research programs.

In research and development, it is the duty of the government to compensate for the shortcomings of the industrial sector. On the level of basic research, government is entrusted with extended responsibilities, generally assumed by the network of universities and research institutes.



Thanks to advanced technology, gas turns into an electricity conductor (SF-6). Reynolds Aluminum Company, in Baie-Comeau.

Photo: François Boulay

Applied research is more often conducted within enterprises themselves or carried out at the request of companies in various research centers. The role of government is thus to support the efforts of private enterprise, research centers or universities, and to act as catalyst. It is also important to ensure the rationalization of research activities.

As mentioned, Hydro-Québec fully assumes through its laboratories a leadership role in electricity research in Québec. This activity is increasingly becoming an integral part of the development strategy of the public corporation. Nevertheless, the government must directly support and encourage research on energy efficiency, the development of alternative energy sources, and the development of technologies for the utilization of conventional energy forms. This effort has now been underway for some years.

It will be increased and strengthened, as additional appropriations will be accompanied by new structures. Indeed, the Québec government will create a fund for research on energy efficiency and diversity and will set up an advisory committee consisting of representatives of the sector for the selection of projects.

ENERGY AND THE ENVIRONMENT

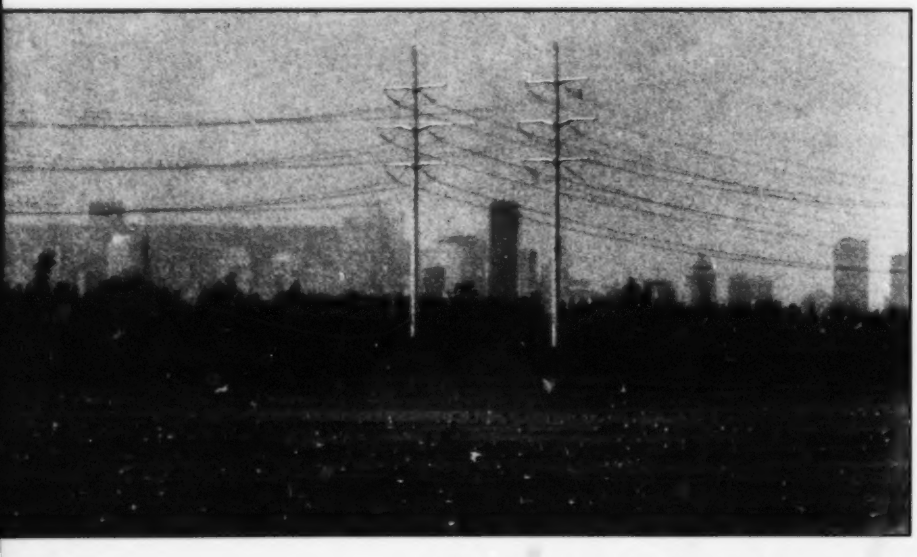
- **Alternative Energy Sources**
- **Fossil Fuels**
- **Electricity**

The Economy and the Environment: a New Outlook

The greater well-being of the people cannot be explained solely by economic factors or the rise in the standard of living. It is also measured by the environmental criterion of protection and improvement of the quality of life. An indispensable equilibrium must therefore be sought between the imperatives of economy and ecology. The energy sector, as all areas of economic activity, is now facing this challenge. The development of the various energy sources in Québec must be looked at from this standpoint.

As concerns the environment, energy development in Québec is based on very positive experiences. Indeed, over the past fifteen years, the inroads made by natural gas as well as the expansion of the hydroelectric production and transportation network have been achieved by integrating the environmental, technical and economic dimensions in both the planning and implementation of projects. Environmental studies, systematically carried out in view of installing facilities in the best of conditions, have greatly contributed to increasing our knowledge relating to the sensitivity of the environmental components of the territory.

In Québec, a large part of the efforts to integrate environmental dimensions with energy choices are devoted primarily to hydroelectricity. In the last few years, research efforts and concerted action have focused mainly on hydroelectric development projects. The attention thus given hydroelectricity, much to the contrary, does not stem from environmental effects more harmful than other forms of energy. It is the result of, first, hydroelectricity's place in Québec's energy development; second, the government's role in this area; and, third, the integration of the environmental dimension it was possible to accomplish more than for any other form of energy. For the Government, however, all energy activities must be viewed from the standpoint of the quality of life and the protection of the environment.



These elegant towers show Hydro-Québec's concern for a quality environment.

Alternative Energy Sources

Environmental Challenges

Most processes relating to alternative energy sources are still being developed and have not been widely distributed commercially. However, many of these processes meet with the approval of environmental protection groups because of their limited scale and because they contribute to recovering energy and sometimes even to improving the environment.

- ***Recovering Energy from Biomass and Urban Waste***. Recovering energy from residues, producing energy through the com-

bustion of urban and forest waste, and processing agricultural waste, all bring solutions to environmental problems of waste management, at costs more acceptable to society, given the energy thus produced.

If these processes correct certain environmental problems, they are not, however, completely harmless. In effect, the combustion of such materials can emit pesticide residues, and liquid biocombustibles can contain irritating and even toxic substances. Recent research shows, moreover, that pollution through polycyclic aromatic hydrocarbons is closely tied to wood combustion. The release of these highly toxic substances into the environment could deeply affect the development of processes if, when acceptable thresholds have been established, adequate devices to control their content are not introduced and made available at an acceptable cost.

- ***Wind and Solar Energy***. The use of solar energy constitutes one of the most environmentally advantageous alternative forms of energy since it has shown no harmful ecological effect. Similarly, the use of wind energy presents no direct ill effect on the environment. However, if their use has no direct effect, the facilities to capture the rays of the sun or the movements of the wind required to produce energy can have important visual and functional effects if used on a large scale for mass production. Used as a supplementary source, these facilities are, however, environmentally acceptable.

- ***Recovering Energy from Thermal Waste***. Industrial thermal waste can cause harmful temperature shocks to the environment. With recent technologies, it is possible to recover energy from this waste. It is essential, however, to see that this recovery does not lead to the release of toxic substances into the atmosphere or closed quarters.

- ***Alternate fuels and hydrogen***. The development of alternate fuels, such as alcohol produced from cereals and wood waste, should in the long term reduce the harmful effects of burning fossil fuels. The industry could eventually consider the possibility of using this alcohol to replace the lead in gasoline as an anti-knock agent. On a longer term basis, the use of electrolytic hydrogen as fuel points to energy systems with only few effects on the environment since hydrogen combustion residues turn into water upon contact with air.

Government Orientations

Alternative energy processes bring certain elements of solution to the environmental problems we are actually experiencing. In addition, a wider dissemination of these processes could eventually curtail residential consumption of conventional forms of energy significantly, oil in particular. The development of these energy production technologies require, however, great caution since they can also be harmful to the environment.

In the coming years, the government plans to continue supporting the development of alternative energy sources using the available and renewable resources most likely to alleviate environmental problems. The assistance it will grant for research and experiments in new or improved processes will be contingent on the parallel development of the devices required to ensure the protection of the environment. It will therefore ensure that, prior to the marketing and distribution of these processes, they will have been rigorously tested as to the protection of the quality of the environment.

Fossil Fuels

Major Goals

In Québec, environmental goals relative to hydrocarbons concern in particular three sectors of activity, namely, exploration and oil extraction, the security of facilities and the preservation of the quality of products, and the transportation of these materials. Government responsibility for environmental matters is therefore limited in these areas because production is extremely low.

Exploration and Extraction

Exploration and especially extraction can be qualified as marginal activities with respect to the entire Québec energy sector. Nonetheless, they require strict controls to prevent any contamination of the environment, particularly by drilling mud or exposed substances, and to ensure security of operations.

To this end, these activities are governed by the Mining Act and the Environment Quality Act. They will be controlled all the better since regulations relating specifically to these matters have now been revised, in accordance with the evolution of techniques and work habits, in order to ensure public safety and the protection of the environment.

Safety of Equipment and Quality of Products

The Petroleum Products Trade Act has recently been amended by passage of the Act respecting the use of petroleum products. As concerns the protection of the environment, the new fields of application that the Act covers are aimed at increasing the security of individuals and the quality of facilities, in particular to prevent soil contamination, which could occur as a result of leaks or accidental spills. More rigorous standards and stricter measures will henceforth be applied for violations of the law.

Regarding the environment, transportation and storage facilities as well as the processing of products, particularly in the petrochemical industry, present a risk factor because of the serious consequences that could arise from any human neglect or technical failure.

As concerns the quality of petroleum products — which mainly refer to sulfur and lead contents, the octane index, and volatility — the government is coordinating the efforts of the departments concerned in view of establishing a just balance between environmental and economic requirements.

Natural gas appears in this respect as a source of relatively pollution-free energy. Recent transmission facilities meet strict environmental requirements. Combustion facilities installed to replace oil-fired systems are more efficient. Combustion wastes released in the atmosphere are significantly less than that of oil.

Transportation

The transportation of petroleum products is governed mainly by the Transportation of Dangerous Goods Act, with the exclusion of maritime transportation, regulated by the federal government. In this area, despite all the preventive measures, road, railway and shipping accidents can seriously contaminate the environment. However, oil and gas pipeline networks, whose construction is subject to the Environment Quality Act, entail smaller risks.

Government Orientations

In the years to come, efforts will center on the strict application of regulations, especially to prevent soil contamination. In addition to monitoring the safety of facilities, the government will continue its efforts to ensure the quality of products and the control of air pollution caused by the combustion or the evaporation of petroleum products.

The surest means to continue improving the quality of the environment appear to be programs aimed at reducing the share of oil in the energy balance sheet, particularly for heating purposes, support for research in equipment curtailing pollution in transportation and industry, and incentives for energy efficiency.

Over longer periods of time, the substitution of natural gas for oil in the transportation sector could, according the U. S. Environmental Protection Agency, reduce air pollution caused by combustion by half and eliminate evaporation problems completely. The use of propane could also be considered for these same purposes. Development in this area constitutes, therefore, a fairly promising way of improving the quality of the environment.

Electricity

The availability of electricity and its particularly low cost in Québec, compared to the rest of North America, without a doubt contribute to the quality of life of citizens. At the present time, electricity output relies basically on conventional production methods such as nuclear, thermal or hydroelectric plants. In Québec, hydroelectricity provides over 97% of electricity output.

- ***Nuclear Energy***. Given the favorable potential and production costs of hydroelectricity, the Québec government need not produce, in the foreseeable future, additional electric energy through nuclear fission. As for environmental consequences, nuclear energy is the most controverted form among the general public. The accumulation of radioactive waste, the risk factors associated to defective operation and the necessity to evacuate the people in an emergency, all contribute to the social pressure against the proliferation of nuclear power plants.

- ***Conventional Thermal Energy***. According to prevailing processes, conventional electricity-producing thermal power plants use either coal or heating oil as fuel. Despite processes developed to reduce the emission of harmful gases in the environment, coal combustion, besides the solid waste it produces, remains one of the major sources of sulfur-dioxide and nitrogen-oxide emanations in the atmosphere. Heavy fossil fuels, such as diesel oil, which fire thermal power plants, generally have a sulfur content lower than that of coal but definitely higher than that of natural gas.

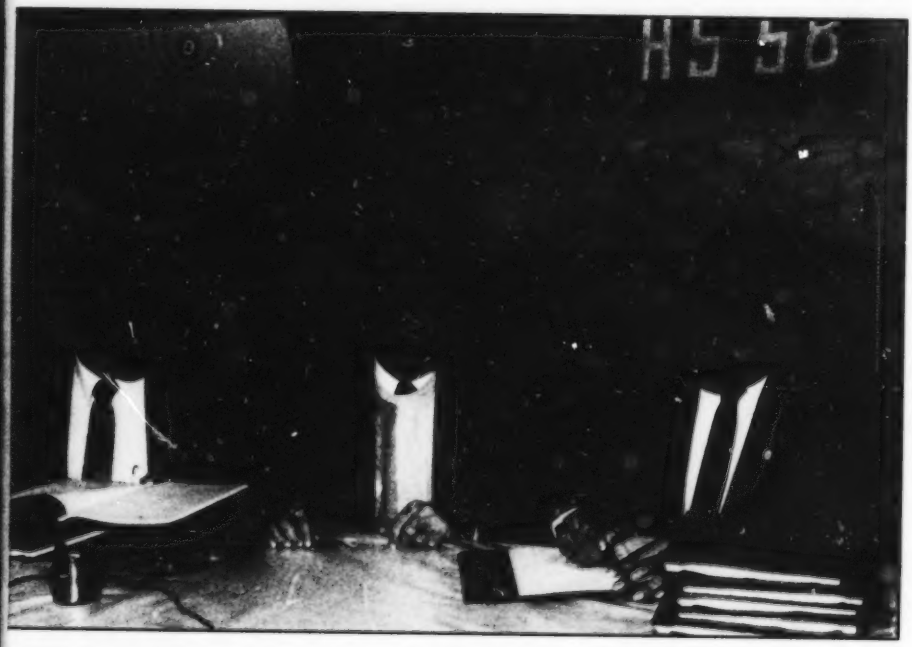
However, sulfur-dioxide emissions are in large part responsible for acid rain and the deleterious effects they actually have on Québec, such as forest dieback and deterioration of water quality. The government believes, therefore, that for Québec nothing can be gained environmentally from this method of energy production, except in remote regions, where neither gas nor hydroelectricity have yet penetrated.

Hydroelectric Energy

Hydroelectricity is a form of energy whose technology is well mastered. The level of pollution generated by hydroelectricity is relatively low. This form of production is based on a constantly renewed resource. Its

use releases no emanations or residues. Environmentally, Québec is therefore entirely justified in giving priority to the development of its hydroelectric potential and in pursuing the penetration of electricity on the energy market. However, one cannot say that the production of electricity is without effect on the environment or without risk to it.

The installation of production and transmission facilities on the territory disrupts, either directly or indirectly, the environment where they are inserted. Measures are being taken to lessen the environmental impact in most places where it is detected. However, some effects remain unknown; studies and research must therefore be pursued on this score. A summary of the major effects of hydroelectric projects as well as the solutions that are already applied offers a realistic vision of the environmental problems resulting from hydroelectric development and suggests elements for a solution to the population's growing concerns.



Signing of the La Grande Agreement with the Crees of Québec at Chisasibi in 1986. From left to right: Raymond Savoie, Minister responsible for Native Affairs; John Ciaccia, Minister of Energy and Resources; Ted Moses, Grand Chief of the Crees.

Direct Environmental Impact

- ***Production Facilities.*** The construction of production facilities, such as power plants, in some cases requires the creation of huge reservoirs. The flooding of vast forest lands, which decomposes vegetation, triggers the formation of tannic acids that eat away at the rocks and release the mercury present in large quantities in the Canadian Shield. The mercury is harmless until it is transformed into methyl-mercury, a source of contamination of the food chain. However, research confirms that this phenomenon is resorbed in time and that, over a period of twenty years, the situation tends to return to normal.

Under the 1986 Mercury Agreement, the Québec government, the Cree and Hydro-Québec will seek to learn more about the phenomenon and find solutions. The total cost of the program, between 1987 and 1997, will be approximately 20 million dollars.

The flooding of territories to develop the energy potential of the northern Québec regions cannot but affect the native communities that live there. Because of the fragile nature of the ecosystems and the difficult conditions of development, promoters must make special efforts to protect the environ-

ment. Accordingly, the James Bay and Northern Québec Agreement — signed in 1975 between Hydro-Québec, the Société d'énergie de la Baie James, the Société de développement de la Baie James, the Québec government, the federal government, as well as the Crees and Inuit of Québec — governs the rights and obligations of each of the parties on the Québec territory north of the 49th parallel. It determines the conditions for installing facilities in these regions. A second agreement, the La Grande 1986 Agreement, concluded with the Crees of Québec, is aimed at establishing adequate insertion measures in connection with Phase II projects of the La Grande complex. This agreement includes the payment of 112 million dollars to the Crees.

The government is also concerned with territories not governed by agreements but inhabited by native peoples. It encourages Hydro-Québec to maintain close relations with the communities affected by the projects and to provide for their participation in the various stages of the work: studies, construction and, where appropriate, operations.

- ***Transportation facilities***. The most direct impact of energy transmission lines is the right of way they occupy and that, by the very fact, they close off to other uses. Beyond the indemnities paid, the government supports the search for compensatory measures that can lessen, and even eliminate, the negative effects of hydroelectric installations. It encourages the diversified use of rights of way particularly for the benefit of local populations. Attenuating the visual impact, especially on scenery whose value is socially recognized, is among the government's priorities. This was recently demonstrated by the decision on the underwater crossing for the Radisson-Nicolet-Des Cantons transmission line between Grondines and Lotbinière.

For this line, the continued exchanges between the interested parties as well as the need to protect the environment prompted scientific research and technological experimentation with respect to the underwater crossing. Consultations aimed at integrating environmental concerns with the technical and economical analyses of projects were also launched with respect to the Des Cantons-Maine interconnection in the Estrie region, supplying power to the Iles-de-la-Madeleine, the Sainte-Marguerite power plant on the North Shore, and to the replacement of the Les Cèdres power plant near Montréal.

Indirect Environmental Impact

The impact of hydroelectric installations is not always immediately apparent. Questions have often been raised, in the mind of the public, about the possible effects of high-voltage lines on the health of humans and animals, the utilization of polychlorinated biphenyl (PCB), phytocides and electrical nuisance. Research, to which the government is associated, is actually being conducted on these subjects.

Until now, the conclusions of the international scientific community are that brief exposure to the electric and magnetic fields thus created is harmless to human or animal health. The effects of prolonged exposure are yet to be confirmed. Hydro-Québec is conducting a joint study on this subject with Ontario Hydro and Electricité de France, a study to which it expects to devote 7.4 million dollars by the end of 1990.

Research is also being carried on to learn the carcinogenic potential of PCBs. A committee composed of PCB users, including Hydro-Québec, was set up in 1985. The goal of the committee is to eliminate PCBs by adopting

Approbation Procedures Applied to Major Hydro-Québec Projects

Hydro-Québec's major projects go through many government authorizations: a first order in council authorizing a draft-design study; an authorization certificate following a study on the project's impact on the environment; an authorization from the Commission de protection du territoire agricole if the project affects that land; a notice of compliance to the objectives of the Regional County Municipality's management plan, where such a plan is in effect; a second order in council to authorize the construction and purchase of property or real estate rights.

Where a project is aimed at export markets, the NEB must also issue an export licence and a certificate of public convenience and necessity, if facilities must be built. Any transmission line crossing the border must also be authorized by the International Boundary Commission.

Actually, there is no formal integration of these different procedures, or coordination of the departmental and public consultations they entail. This situation leads to an overlapping of responsibilities and a duplication of tasks, not to mention extended delays.

Moreover, the fragmentation of separate plans for the protection of resources and the environment does not permit a global and integrated approach regarding the multiple effects of projects; nor do current public consultation procedures take into account, from the very beginning of project studies, the growing environmental concerns of citizens or the new social values arising from these concerns.

the necessary measures. Hydro-Québec intends to eliminate PCBs from its equipment within eight years. More than one hundred million dollars will be earmarked for the implementation of the main activities of its plan of action, 75 million of which by 1990.

The control of vegetation under overhead transmission lines is in some cases assured by the spraying of phytocides, whose use is generally restricted to regions far from dwellings or difficult to reach. The potential impact of these substances on the environment and on public health has led Hydro-Québec to undertake a research program. Long-term environmental monitoring will result in greater knowledge of the effects and the optimal use of various biological methods of vegetation control.

Electric energy transmission facilities can create radio-electric interference as well as scrambled telephone lines. These inconveniences occur especially near transmission lines. The phenomenon is well known and controlled. Besides, the corrosion effect of some underground metal conductors caused by the return current of an underground direct current line has been the object of research and can now be treated effectively.

This account of the major environmental effects of hydroelectricity shows that the stakes involved are far from negligible. Certain phenomena are well known, controlled and attenuated by adequate measures. Others, real or perceived, are not so well known, but the government intends to see

that studies and research programs are carried on and public safety is preserved.

Reconciling Goals

From the indispensable standpoint of ensuring lasting development by integrating economic and environmental goals in long-term planning, the government must meet a strong challenge by hydroelectric energy production and transmission. The major goals of hydroelectricity with respect to the environment are in practice inseparably linked to economic and technical ones. Consequently, the study of development projects should reconcile all these goals from the start.

- ***Northern Québec***. The legislative measures and agreements that govern the James Bay and northern Québec energy development projects are seen as progressive the world over. The process that led to the signing of the agreement represents a sustained effort aimed at the integration of environmental, technical and economic considerations in specifying the conditions of the construction of hydroelectric facilities and power plants, an effort to which the native communities have been closely associated.

This development has sparked accelerated social, institutional and economic changes in the way of life of the northern communities. It is expected that in the future these communities will increasingly want to take charge of the development of their territory and its resources, and that they will remain watchful as regards the protection of their environment. Thus, the efforts initiated early in the 1970s to harmonize goals will be carried on and developed on a lasting basis.

- ***Southern Québec***. The situation in southern Québec is very different. More organized and populated, this territory is used in ways that often express divergent or contradictory priorities and interests. Its resources are fiercely sought and the introduction of new projects, therefore, often conflicts with established uses.

This fragmentation in the allocation of resources is also reflected in the application of many laws and regulations affecting the regions; some of these are general, others particular, but all are aimed at protecting property and the environment. Thus, hydroelectric development projects are submitted to separate reviews and authorizations each covering a limited field; however, a relationship of mutual dependence is not necessarily established between their various effects, nor a common vision defined.

Moreover, public consultations provided under various laws are held at the end of the study process. This makes it more difficult to integrate the emerging social values regarding the protection of the environment. During these consultations, the economic dimension of the project is often brushed aside and only the environmental aspect is considered. This often results in emphasizing the disadvantages of a project without showing its benefits.

To these difficulties must be added administrative delays, the postponement of authorization deadlines, and conflicts over jurisdiction. Solutions must therefore be sought to ensure a more effective participation of citizens and organizations in the study of hydroelectric development projects, and to ensure the integration of the economic, technical and environmental dimensions as much in the study and review of projects as in their authorization. The reconciliation of goals lies in part in this integration.

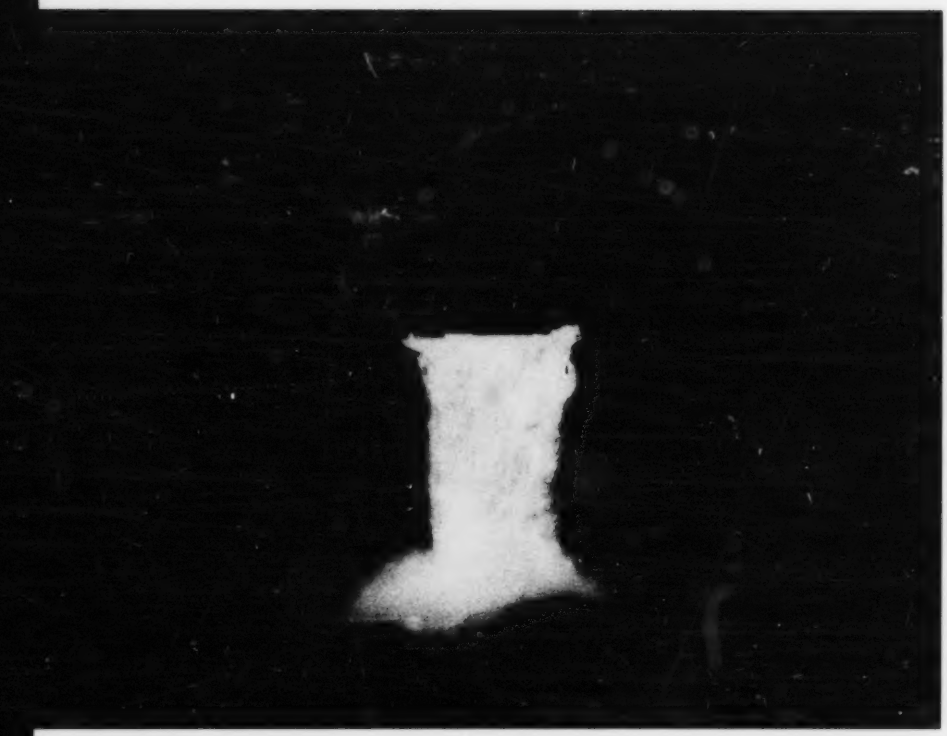


Photo: François Boulay

Government Orientations

In the energy sector, the government intends to pursue an environmental protection policy that guarantees the lasting development of the economy and of resources. Accordingly, action priorities in the hydroelectric sector will be as follows:

Institutions

. The government will continue to submit to rigorous environmental studies the installation of new transmission facilities, the construction of power plants and transforming stations as well as the creation of reservoirs.

. It will seek mechanisms capable of ensuring a better integration of economic, technical and environmental components when reviewing development projects by creating, if need be, a coordinating committee to promote consultation and unify procedures, or by broadening the mandate of some agencies.

. With respect to transmission lines, it will take the concerns of citizens into greater consideration.

Customer Service

. The government will ask Hydro-Québec to pay special attention to the visual impact of overhead transmission and distribution lines. This effort will concern primarily environments that are highly valued as tourist attractions or heritage sites.

. In cooperation with various parties, the government is seeking solutions to reduce the problems arising from parasitic tensions in animal breeding enterprises.

Environmental Protection

. Since approximately 80% of Québec's population lives in the St. Lawrence Valley, the government has already given priority to this environment. The protection of the visual integrity of the river itself is part of this concern. The government therefore requests that Hydro-Québec give priority to the protection of scenery with acknowledged value. In addition, the government will see that no new corridor is henceforth open to the passage of overhead lines across the St. Lawrence.

. The government will entrust Hydro-Québec, while pursuing its program to im-

prove existing facilities, to undertake a program to dismantle lines and stations that are no longer in service.

Finally, the government expects appropriations for the municipalities development program to be allocated above all to improving the environment. Hydro-Québec must also seek, as far as possible, a diversified and integrated use of reservoirs and rights of way, and encourage the best use of the architectural and historical potential of power plants no longer in use.

THE ROLE OF THE GOVERNMENT

- **Inform**
- **Promote**
- **Protect**
- **Develop**
- **Represent**

In an economy based on free enterprise, where responsibilities are shared at different levels, it is neither possible nor desirable for a government to attempt to carry out all its objectives by direct intervention.

The role of a government is rather to inform economic agents and, at times, encourage them to act where benefits for all of society far outweigh mere private profitability. The government must also protect all citizens against potential abuses. The State can also act as an economic agent in very specific cases where of itself private enterprise is unable to meet the challenges, especially of economic development. Lastly, the government's mission is to defend and promote Québec's economic and political interests before other levels of government in Canada and abroad, as well as to back the efforts of its institutions and enterprises on foreign markets.

In carrying out the separate objectives of its energy policy, the Québec government must simultaneously assume each of these roles.

Inform

The smooth operation of a market economy depends on its economic agents being well informed. For many years, the ministère de l'Énergie et des Ressources has increased its efforts to place at the disposal of companies and consumers the information necessary for them to make decisions. This effort has increased particularly over the past years with the publication of a yearly review of statistical information on energy in Québec, detailed forecasts of energy demand, documents issued periodically containing analyses of the relative positions of competing energy forms and, more recently, with the publication of a newsletter by the Bureau d'information sur les prix d'essence.

Information also covered equipment and energy conservation measures. Information has been provided through participation in many shows and exhibits as well as by means of technical guidebooks and a variety of documents or booklets. The government has also relied on organizations that constitute excellent information channels, such as the Association québécoise pour la maîtrise de l'énergie (AQME) and the magazine "La maîtrise de l'énergie" it publishes.

In the coming years, the government plans to maintain and even increase this activity. For example, in order to reap the full benefits of competition, the new context of deregulation, especially natural gas deregulation, will require that consumers be better informed of prevailing market prices and contract conditions; the government will apply the necessary means to carry out this mandate.

In the area of energy efficiency also, the government means to pursue its efforts not only to raise the awareness of the parties concerned, but to inform and train them. In this respect, Hydro-Québec and other energy suppliers will have a role to play.

Promote

A certain number of private activities directly benefit all of society. That is why the government has the duty of encouraging them as much as it can.

Various programs are designed to assist the development of new technologies and their dissemination. This is true in particular of research and development, where the government supports the efforts of the private sector and universities. This assistance is justified by the long-term benefits it will provide to society. With respect to energy

efficiency, technical and financial assistance is granted to identify profitable measures that can be applied.

The government also acts through tax incentives. It has granted important tax cuts to facilitate the adjustment of the refining industry to the changes that have occurred in the demand structure. Tax breaks are granted some alternate fuels replacing gasoline.

Similarly, with Hydro-Québec's cooperation, rebates and guarantees on electricity consumption granted certain companies have led to the establishment of new plants and the creation of many jobs in Québec. A case in point is the recent establishment of Norsk-Hydro in Bécancour.

These incentives to encourage private enterprise will be carried on so as to encourage the economic development of Québec, including that of the outlying regions.

Protect

The government guarantees public safety and the protection of the environment. It is equally responsible for consumers dealing with natural monopolies and imperfect markets. This is one of its essential roles, for which it has at its disposal a slew of regulatory and legislative instruments.

In recent years, the growth of economic activity has placed increasing pressure on the environment. New awareness of the dangers and negative effects that have arisen has led governments to further regulate energy production, transmission, distribution and use.

In like manner, laws and regulations respecting the safety of equipment have been tightened to ensure greater protection for citizens. Thus, in recent years, the parts of the Mining Act that affect the exploration and operation of oil and gas deposits as well as of underground storage have been revised. The Petroleum Products Trade Act has also been replaced accordingly.

When consumers deal with distribution monopolies, the government must ensure that the prices and rates charged are fair and reasonable. With respect to natural gas, it accomplishes this task through the Régie du gaz naturel whose Act has recently been amended particularly to better adapt this agency to the recent deregulation of natural gas prices and markets in Canada.

As concerns electricity, the importance of Hydro-Québec in the economy and the cost of electricity consumption in the budget of individuals has prompted the government to directly assume the protection of consumers.

The intent of the government in this area is to maintain consumer protection mechanisms in effect. In this respect, the government plans to take into greater consideration environmental aspects even when designing energy installations.

Develop

Québec's recent history has demonstrated to what extent it could be useful, even necessary, to have a powerful enterprise capable of mobilizing important funds and of undertaking often huge projects for the benefit of the Québec economy.

The creation of Hydro-Québec in the 1940s, followed by the acquisition of the most important producers and distributors during the 1960s, has given Québec one of the largest electricity producing corporations in the world. In particular, it has led to the development of the Manic-Outardes and James Bay complex, which constitutes the greatest driving force for economic development we have ever controlled. This project, which doubled Hydro-Québec's output capacity, has enabled electricity to capture an important share of the energy balance sheet and attracted new industries to Québec.

The government intends to pursue through Hydro-Québec the development of the huge potential that remains untapped. Beyond simply providing a public service, this action is to seek opportunities for economic development and job creation.

SOQUIP is another means the government has taken to reach its energy objectives. The charter that created SOQUIP in 1969 stipulated that its field of activity was the entire range of hydrocarbons, from exploration to production. SOQUIP is a corporation that allows the government, in a sector where its means of action are more limited, to encourage the execution of projects fostering economic development. In recent years, SOQUIP has helped increase the distribution of natural gas in Québec and develop its markets. In joint ventures with partners from the private sector, it has also undertaken to provide the Québec petrochemical industry with greater access to natural gas liquids. It can thus be seen that in areas of hydrocarbons and electricity, which are both vital to Québec's economy, the government has become entrepreneur for the benefit of the people.

Represent

The profound transformations of the energy sector in Québec over the past fifteen years are to a great extent the result of an aggregate of commercial, economic and political changes, of events and decisions that occurred outside Québec. In this context, the Québec government had the mandate of representing the interests of Québec consumers before other governments.

Such was the case in the fossil fuel sector, where the object of Québec's interventions was to gain greater access to supplies from western Canada.

Government action also centered on increasing trade and cooperation with a number of countries, especially our neighbors in the northeastern United States.

As regards electricity, for instance, Québec's advantageous situation and favorable conditions on external markets have helped boost, particularly in recent years, Québec's electricity exports to neighboring provinces and American states, and thus lay the groundwork for solid regional economic and energy cooperation, while improving Québec's balance of trade in the energy sector.

Québec has also been very successful in cooperating with a number of other countries, especially French-speaking nations. Thus, the Institut de l'énergie des pays ayant en commun l'usage du français will be established in Québec City in 1988. This institute will help increase exchanges between Québec and all French-speaking countries in the field of energy through training and information activities. For the first time, the Agence de coopération culturelle et technique des pays de la francophonie will set up a subsidiary institution outside France.

Orientations

The government's role as representative of the people will be of growing importance during the 1990s to defend Québec's interests as well as to promote trade and cooperation abroad.

In Canada, Québec is now in a situation where it must use the necessary means to take advantage of deregulation in the oil and gas sectors begun in 1985. As it has done for the past two years, the government will continue working vigorously to ensure the economic and technical viability of the Sarnia-Montréal oil pipeline, as well as the recovery of Montréal's petrochemical industry through natural gas liquids at competitive prices.

In North America, export contracts for guaranteed electric power and energy signed two years ago have helped put energy exchanges with New England, New York State and New Brunswick on a solid base. On this score, the pursuit of government objectives requires not only that it pay particular attention to strengthening its relations with other governments as well as energy and economic representatives of the region. The government will monitor and react, if necessary, to protectionist trends on either side of the border. In this respect, the Free Trade Agreement between Canada and the United States already constitutes a first level of protection against this threat.

The plan, submitted in the fall of 1986 by the federal government, to deregulate electricity exports, has received strong support from the Québec government, but is as yet without any concrete results. Its application is of the utmost importance if the electricity sector is to develop according to its potential and for the benefit of all Canadians, in conditions as favorable as for natural gas and oil exports.

Finally, the expansion and internationalization of the Québec economy strengthen the need to increase relations of cooperation with governments and government agencies confronted with similar situations or interested in developing industrial and technical exchanges.

As can be seen, the role of the Québec government regarding relations with governments of Canada as well as with foreign governments becomes increasingly important in the new energy context. Québec must thus continue to intervene before other governments in energy matters in order to:

- maintain and strengthen security of supplies and access to Canadian fossil fuel resources;

- obtain the liberalization of federal regulations respecting electricity exports;

- promote and develop electricity exports before governments and concerned parties in neighboring provinces and states;

- participate in the development of cooperation between French-speaking countries, in particular by supporting the Réseau énergie de la francophonie [energy network of French-speaking countries] and the Institut de l'énergie des pays ayant en commun l'usage du français;

- encourage the development of industrial and technical relations with a number of governments and institutions on the basis of mutual interest.

A NECESSARY COLLABORATION

The roles of the government in energy matters are therefore many. Each one contributes to reaching the objectives of the energy policy.

To fulfill these roles, the Québec government has available a certain number of instruments of action, some of which are very powerful. However, it is not the government alone that must decide Québec's energy future. The government's energy policy is based on the collaboration of all the parties involved: energy producing and distributing enterprises, energy consuming industries, suppliers of goods and services, other governments; but most of all, the citizens themselves, whose behavior will determine the final choices in the matter.

Gouvernement du Québec
Ministère de l'Énergie
et des Ressources (Énergie)